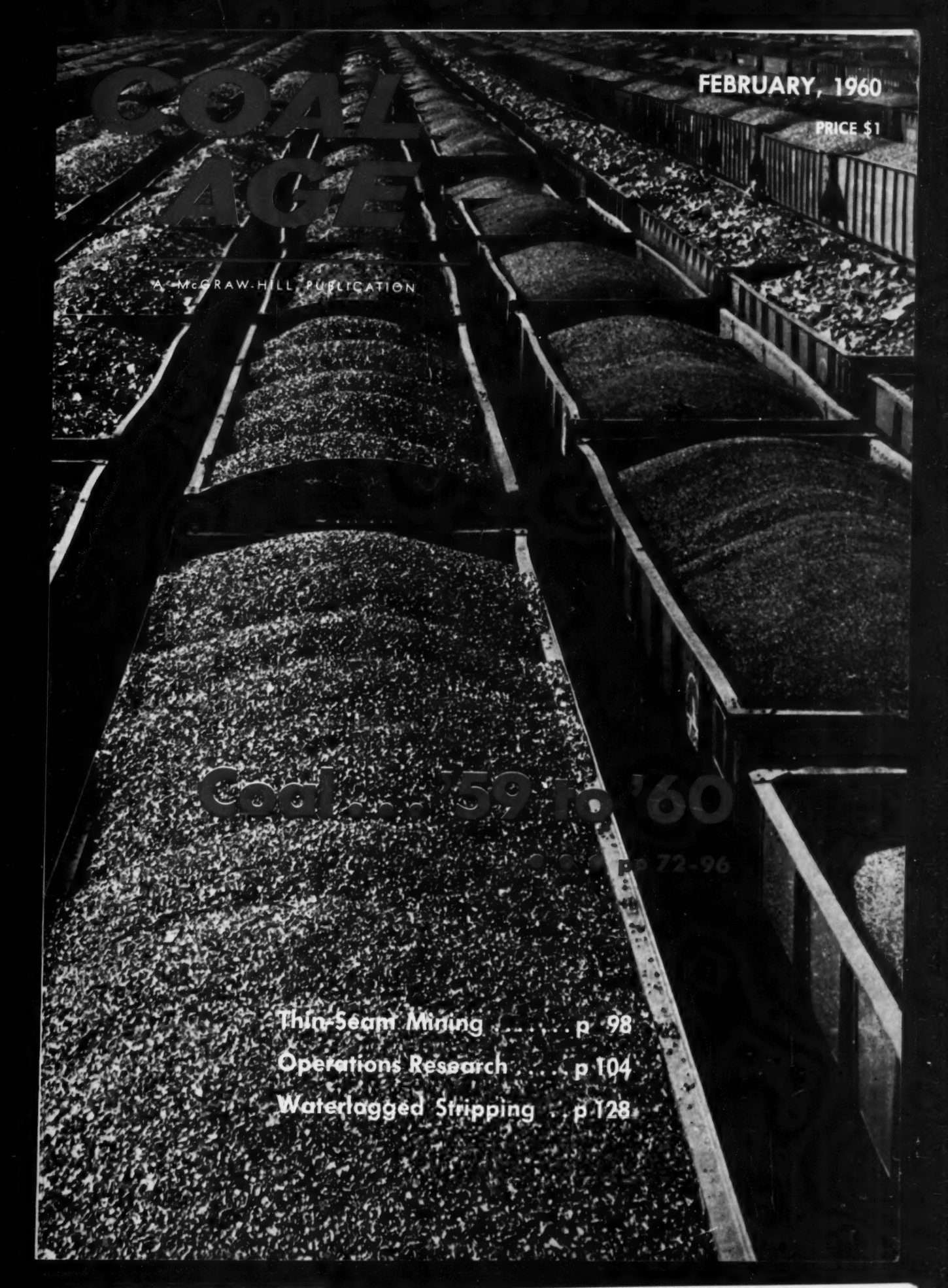
COAL AGE
A McGRAW-HILL PUBLICATION
FEBRUARY, 1960
PRICE $1
Coal . . . '59 to '60
. . . p 72-96
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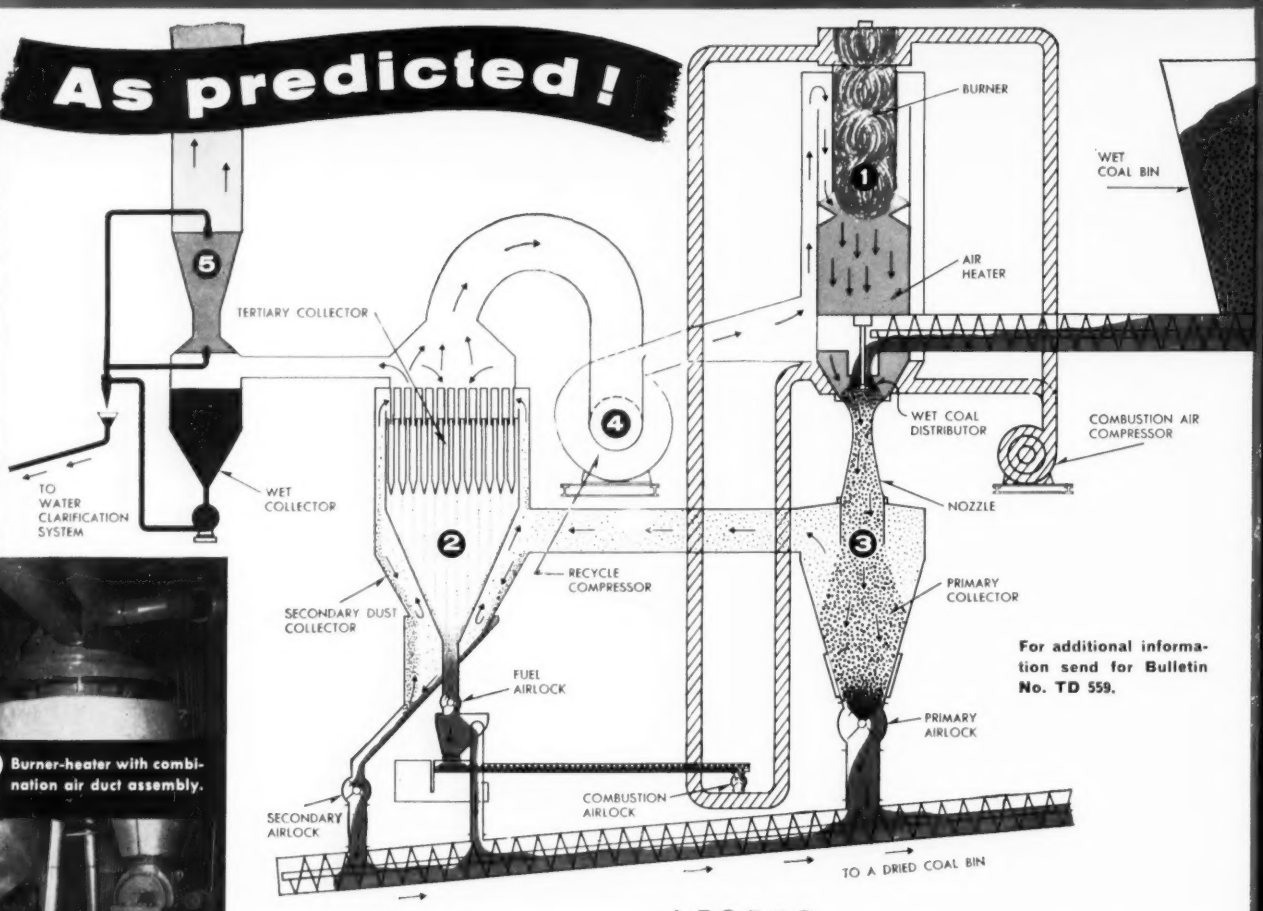
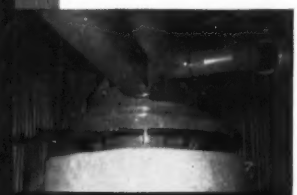
As predicted!



For additional information send for Bulletin No. TD 559.

LEGEND

Large Size Coal (majority of product)	Fine Dust	Extreme Fine Dust	Outside Air (atmosphere)	Flame in Burner	Heated Gas	Recycled Gas	Completely Scrubbed Gas Exhausted to Atmosphere	Partially Scrubbed or Cleansed Gas	Coal	Water Containing Extreme Fine Dust

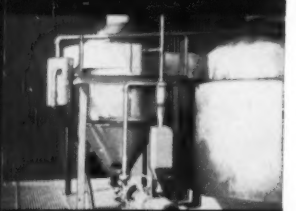


1 Burner-heater with combination air duct assembly.

2 Lower section of secondary dust collector at left;

3 Primary collector with airlock at upper right; and clean coal collecting conveyor.

4 Recycle compressor and upper section of secondary dust collector.



5 Wet collector and exhaust duct for scrubbed gas.

LESS HP = $ $ SAVED
MORE BTU = BETTER PRODUCT

FAIRMONT-built TAILOR STREAM-FLO THERMAL DRYER*

The new Tailor Stream-Flo Thermal Dryer dries feed products up to 2"; recovers the finest dusts. Product is conveyed through drying chamber by gravity, thereby using much less horsepower.

The Tailor Dryer produces a dried product with 200-300 BTU per pound higher heating value compared to other dryers because of the lack of oxidation within the drying atmosphere.

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*Tailor Stream-Flo Thermal Dryer is the trade name for thermal dryers of Tailor & Co., Davenport, Iowa.

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B.F.Goodrich

Hose drains acid pools to keep a coal mine dry

B.F.Goodrich improvements in rubber brought extra savings

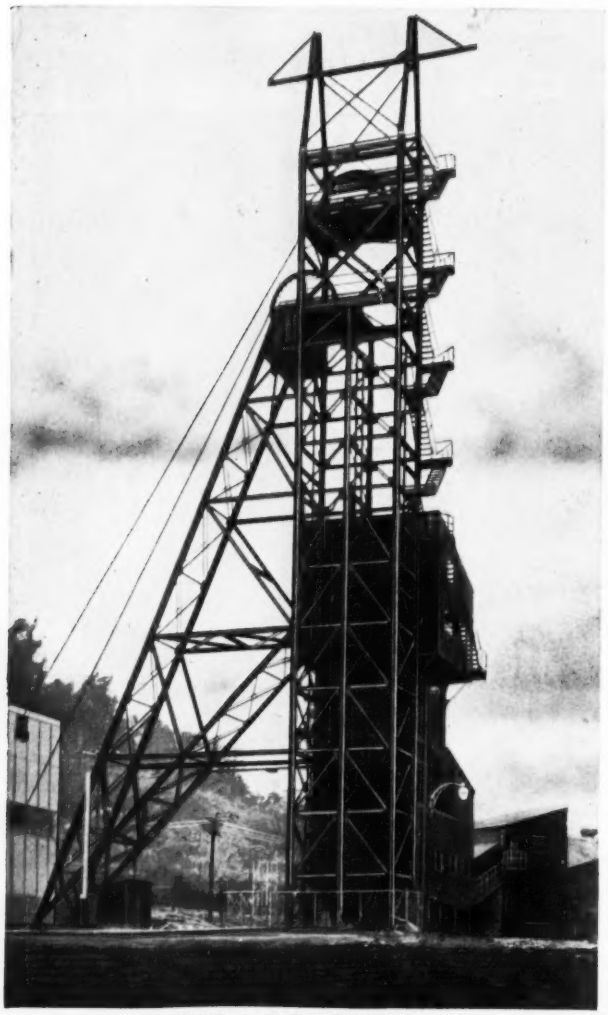
GETTING rid of pools of water that collect in this coal mine is a constant job. At first, iron pipe was used to drain the pools. But the water contains acid that eats holes in metal. Flexible rubber hose, reinforced with wire, was tried, and worked fine until it was run over several times and crushed flat by heavy mining equipment.

When a B.F.Goodrich man heard of the trouble, he recommended a B.F. Goodrich hose that springs back to shape when run over. A continuous coil of hemp rope, specially treated and buried in thick rubber, makes this hose strong enough to stand the suction, yet flexible enough to spring back to its round shape after being crushed.

Since 1953, B.F.Goodrich water hose has worked night and day to keep this mine dry. It has gulped millions of gallons of acid water, been run over countless times by shuttle cars and other equipment. But despite the abuse, it lasts four times longer than the hose used before, saves an estimated 75% in maintenance costs.

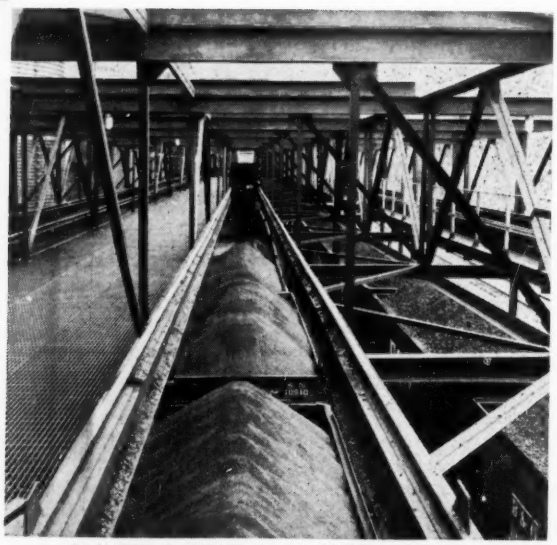
Your B.F.Goodrich distributor has exact specifications for the B.F.Goodrich hose described here. And, as a factory-trained specialist in rubber products, he can answer your questions about the many rubber products B.F.Goodrich makes for industry. *B.F.Goodrich Industrial Products Company, Department M-802, Akron 18, Ohio.*

B.F.Goodrich *industrial rubber products*



SKIP HOIST SYSTEM

INDUSTRIAL ENGINEERING pays Dividends in Economical Production



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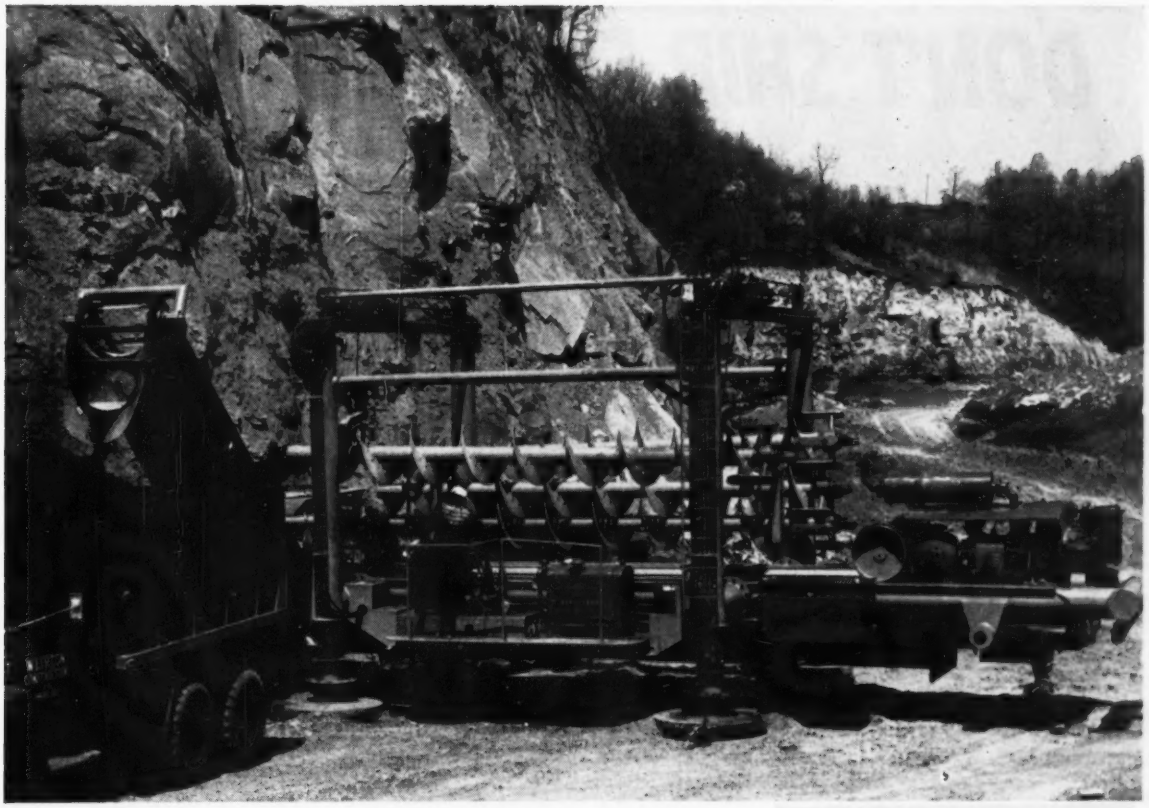
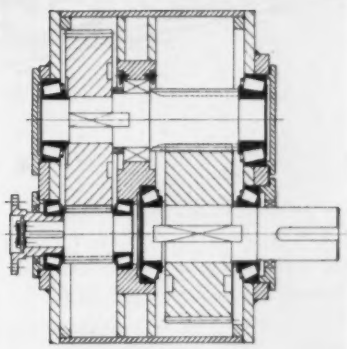


COMPTON "TWIN HEAD" AUGER MAKES THIN SEAM MINING PAY

...Timken® bearing capacity makes it even more profitable

THIS coal auger makes high hourly tonnage production from thin seams possible—and makes it pay. With a drilling depth of 150 ft., it drills within 4¾″ of the bottom for maximum recovery. And to take the heavy thrust and shock loads, assure economical operation, Compton uses 6 Timken® tapered roller bearings in the main drive transmission, 6 in the power divider transmission, 4 in the auger spiders. Here are 2 big reasons why: 1) *They're extra tough* because they're made from the finest bearing-quality alloy steel available. 2) *Extra capacity* makes Timken bearings give longer life. To make sure they do, we have the most modern physical laboratory in the bearing industry for testing bearings, transmissions and other drive units. It runs them under conditions tougher than those found in actual service. To get better machines, be sure they're Timken bearing-equipped. ***When you buy Timken bearings you get:*** *1. Quality you can take for granted. 2. Service you can't get anywhere else. 3. The best-known name in bearings. 4. Pace setter in lower bearing costs.* The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.*



How **COMPTON, INC.**, uses Timken bearings in the main drive transmission of its "Twin Head" coal auger to take heavy loads, cut maintenance.

BETTER-NESS rolls on

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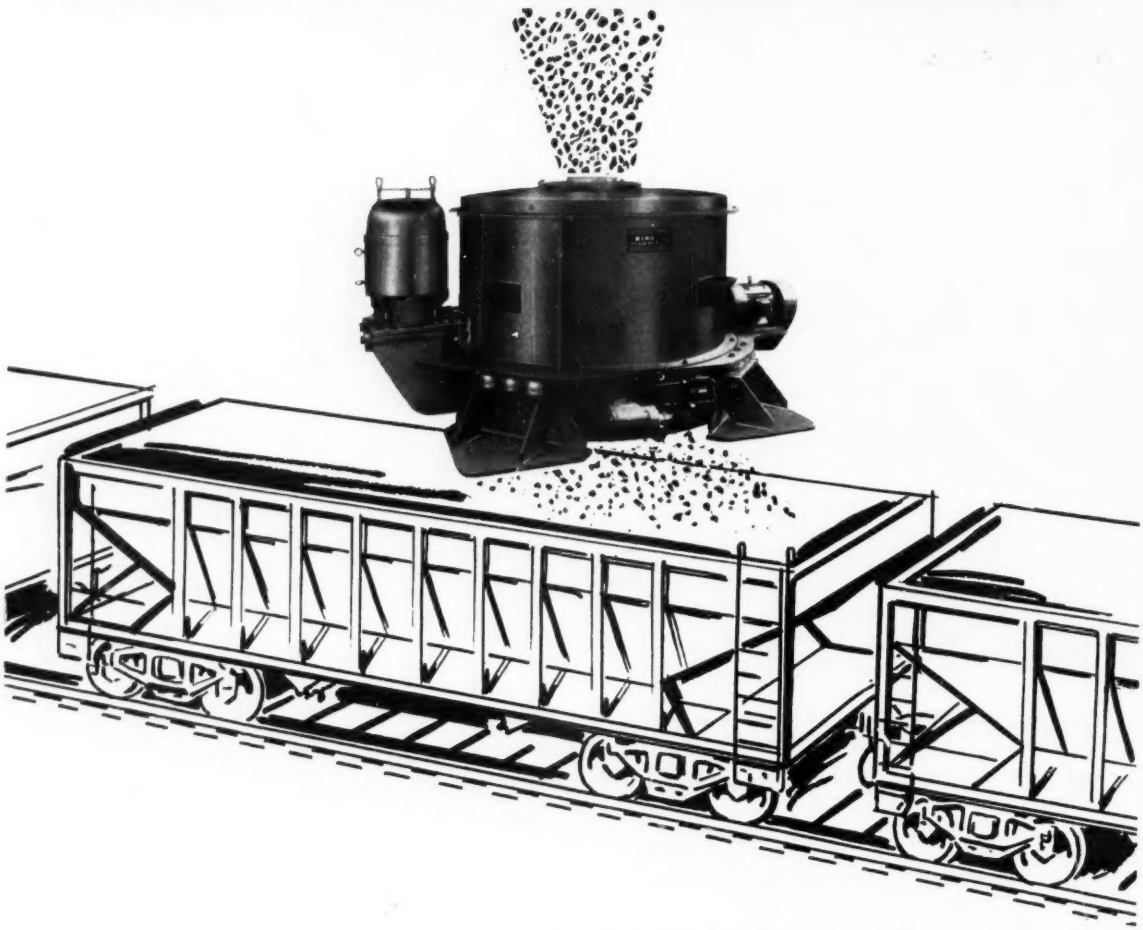
tapered roller bearings

DON'T SHIP FROZEN COAL!



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This Month in COAL AGE

FEBRUARY 1960

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► Coal Outlook

1960: Kick-Off Year for Decade of Growth ..... p 72

Rebounding from '58 and '59 lows, bituminous entered the sixties poised to resume its growth destiny. Estimates for 1960 production range from 430 to 460 million tons. In each of the last 2 yr, output reached an estimated 410 million tons. The rebound assumes record consumption by both electric utilities and steel. Big gains here, however, will be partially offset by relatively small losses expected in "other industrial," retail and export markets. Anthracite output, at 19.5 million tons, continued the leveling-off trend.

Featured—Management Problems and Progress; Coal Around the World; top 15 bituminous producers in '59; Thought for the 60's.

► Technical Developments

Mining, Stripping, Preparation in 1959 . p 80

Deep Mining—New models of continuous miners, high-capacity conventional units and new mining systems to increase efficiency and enhance roof safety were highlights.

Stripping—A bigger wheel excavator, seismic methods in overburden evaluation and big, improved haulage units mark 1959 in stripping.

Preparation—New developments were in precise quality control systems and increased automation of plants, including railroad-car handling.

Spotlight—Complete listing of preparation equipment installations by company, capacity and type.

► Safety, Equipment Sales

Safety in 1959 ..... p 90

1959 Sales of Coal-Mine Equipment ..... p 94

W. H. Young and **R. L. Anderson,** Bureau of Mines

A further improvement in overall safety performance was written into the 1959 record. However, two disasters claimed 23 victims.

Sales of equipment reflect continuing trend toward more continuous mining and augering.

► Continuous Mining

Thin-Seam Continuous Mining Pays Off at TCI ..... p 98

Continuous mining with auger-type machines is paying off in 31-in coal at Tennessee Coal & Iron Div., U. S. Steel Corp., Fairfield, Ala. A comparison of raw coal production on handloaded room sections with a continuous miner belt section in rooms shows that production rose from 8.75 to 21.84 tons per manshift. On advance work production increased from 8.56 to 16.56 tons per face man. Roof control at the working faces is improved because of the elimination of blasting.

Extra Dividend—Continuous mining plans

► Upping Efficiency

How Operations Research Improves Mining Results ..... p 104

Ernest Koenigsberg, Touche, Ross, Bailey & Smart

Face operations in coal mining lend themselves to improvement by the application of the "Queue Theory," which can be employed for various types of cycles and

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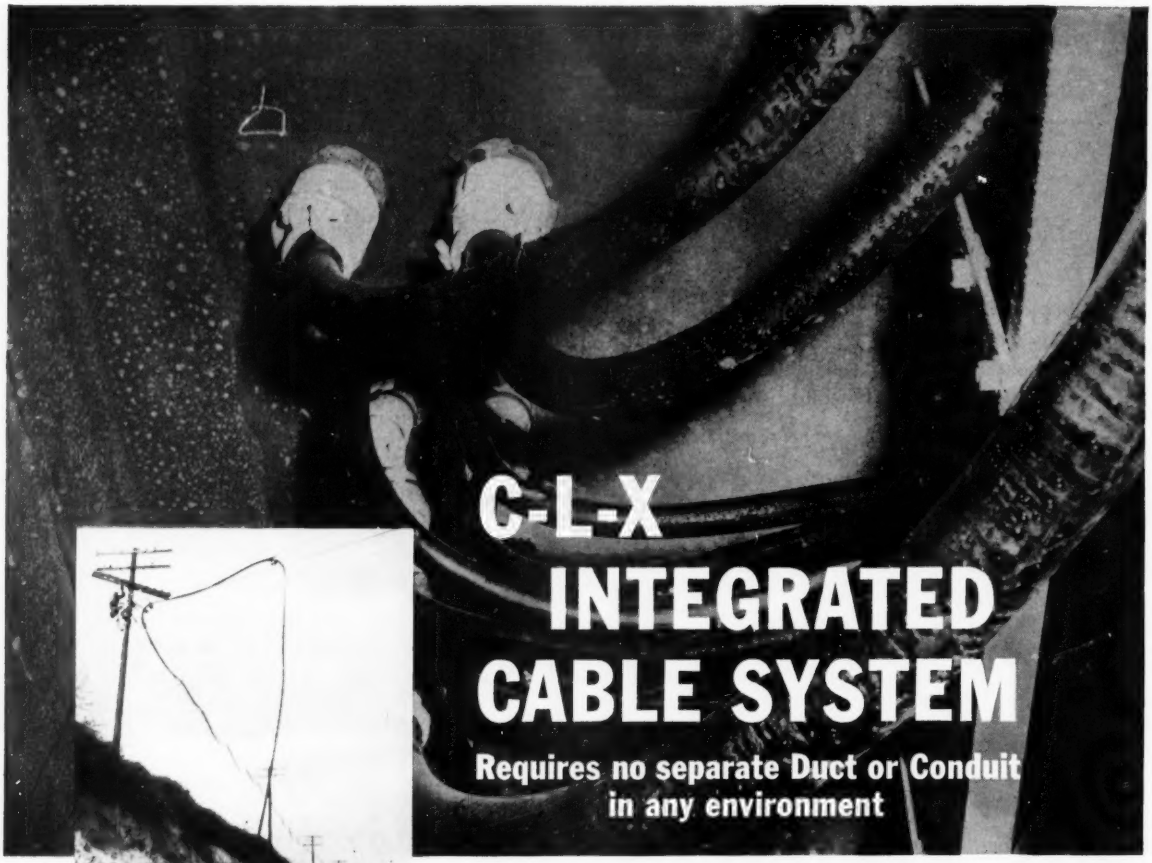

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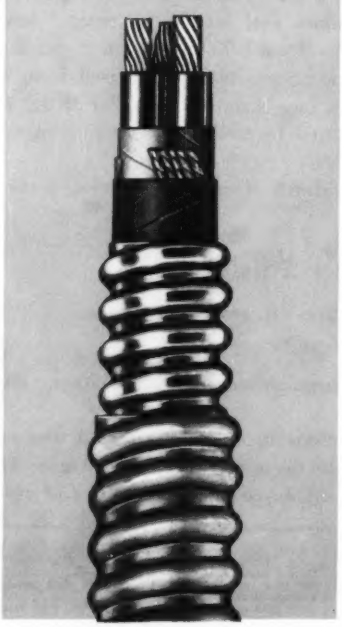
Unusual pliability of C-L-X Sheathed Cables is shown here as the cable is being installed.



The revolutionary C-L-X Continuous, Corrugated, Lightweight, metallic sheath, that Simplex introduced to this country two years ago, is now available in *Aluminum*, *Copper* or *Bronze* as well as the enormously successful *Steel*.

Simplex C-L-X pliable cable systems provide unexcelled ease of installation and mechanical protection.

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Light, and pliable, C-L-X cables are easily installed, and require no special reels.

Now, with corrugated *Aluminum*, *Copper* or *Bronze* sheathed C-L-X cable systems, the low resistance of these metals permits designs where the sheath may be used as a neutral or ground. These metals also permit the use of single as well as multiconductor cable assemblies in a-c power systems.

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various degrees of imbalance in unit capacities. Starting with data obtained by time-studying existing systems, the effect of variations, as in number of shuttle cars, can be calculated.

Rounder-Outer—Computer simulation, where it can be used, and what it can do.

► Maintenance Ideas

How to Store Electrical Equipment . . . . . *p 116*

E. T. Groat, Industrial Sales, General Electric Co., Chicago

Proper storage of electrical parts and spares can often spell the difference between a good maintenance program and a poor one. The storage problem has never been given the attention it deserves nor has there been adequate financing to provide good store rooms. This article covers many of the electrical-storage problems and points the way for reducing equipment down-time and maintenance costs.

Cost Control for Equipment Maintenance p 118

Wayne M. Walker, Assistant Works Auditor, United States Steel Corp., Fairfield, Ala.

Control of the total cost of coal production is contingent to a marked degree upon effective control of equipment maintenance. A good maintenance program not only requires that repairs be made to equipment during production shifts but must also include:

1. Periodic inspection and preventive maintenance.
2. A systematic program of providing major equipment components.
3. A definite program of localized engineering research.
4. A systematic program of major equipment overhauls.
5. A sound program of equipment replacement.
6. A predetermination of allowable expenditures.

► Stripping, Preparation

Badgett Beats Waterlogged Overburden In Western Kentucky . . . . . *p 128*

Long-range planning of over-all pit operations to take full advantage of the dip of the coal bed and close attention to day-to-day problems provide the foundation for successful stripping in water-soaked flat areas at Badgett Mine Stripping Corp.'s new Shamrock mine. Working along the down-pitch edge of the coal, a 16-yd dragline exposes a 100-ft strip of coal and also reaches over to remove 6 ft of water-soaked material from the next cut. Levees built from spoil protect pit from floods. A fleet of 25-ton coal haulers, loaded by a 5¼-yd shovel, carries coal 1½ mi to a 250-ton storage bin at the cleaning plant.

Sidelights—How airplane-type tires on coal haulers reduce tire costs.

This Month in COAL

PERFORMANCE VS. EXPECTATIONS — Forecasts that bituminous would start out 1960 well above the level of the first months of 1959 have proved out. Production continues to run well over 9 million a week, though the plus-10-million figures that probably will be necessary if bituminous is to reach, depending on who is setting the figures, 435 to 460 million in 1960, are yet to come. But if the economic crystal-ballers have not completely misread the signs, they will be along.

For the Record—The preliminary estimate for 1959 bituminous production is 410 million tons. Final figures probably will be close to that and likewise to the 1958 total of 410.4. The anthracite preliminary for 1959 is 19.5 million, compared to the 1958 final of 21.2 million.

FIRMER PRICES FOR BITUMINOUS—A production lift always means firmer prices, and the start of 1960 is no exception. This does not mean that there have been any more than a few increases but rather that concessions are fewer. Later, if production continues to hold at higher levels, some upward adjustments are in the cards. However, the competitive situation is likely to keep adjustments modest in nature. So the year may show an increase of 10 to 15c in average value. The USBM's preliminary for 1959, incidentally, is $4.86, unchanged from 1958. COAL AGE's is $4.75.

BREAKTHROUGH IMMINENT?—When it is carbon for blast furnaces, coal holds the inside track. Now it appears that it will get other carbon business, witness start-of-the-year announcements of new processes and plants in the West to make carbon, blast-furnace feed, and feed for other smelting units from coal not suitable for coke by the usual processes.

By-Product—In addition to the new business these processes will bring to coal, they are one more reason to anticipate a reasonably early breakthrough in other areas—for example, the production of pipeline gas. The huge reserves of carbon in the form of coal will continue, as in the past, to generate work on ways and means of utilization in every possible way.

SLOW GOING—Though some progress was made by the UMW in 1959, it now appears that it will be a long time, if ever, before it gets back to its pre-1959 status in eastern Kentucky. More operators may be expected to sign, especially if business picks up a little, but the truck group, and some of the rail operators are going to be hard to convince. It is difficult to conceive that the union would adjust rates to equalize marketing power, but if it should, eastern Kentucky would be a logical place to start. Meantime, eastern Kentucky bids fair to become another major island in a union sea.

BIG QUESTION—How far overseas exports will drop in 1960 still is a question. Some, however, feel that the total for the year will be around 20 million tons for bituminous. The rate so far would indicate that that figure might even be on the high side. However, some also feel that there will be a strengthening toward the middle of the year. If this occurs, 20 million could turn out to be a sound figure. As to Canada, its takings should be equal to and probably ahead of 1959.

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► Ventilation

Face Ventilation With Auxiliary Fans . . . p 138

D. S. Kingery, Acting Research Director, Health & Safety Research & Test Center, USBM, Pittsburgh

Auxiliary fans and tubing usually solve the problem of face ventilation with continuous miners. The major objective is a high-velocity air sweep across the face in front of the miner to dilute methane. Using a small blower or diffuser in combination with an exhaust system, though it has some potential disadvantages, provides the advantages of both the blowing and exhaust systems. Tubing diameter is important, and fans should have the capacity to deliver the necessary air, including an allowance for leakage. More than one fan-and-tubing installation may be necessary with heavy methane flows. Diffuser capacity in a combination system should be one-third to one-fourth that of the intake when gas emissions are heavy.

Plus—Eleven steps to safety and efficiency with auxiliary ventilation.

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This Month in Mining Practice

HYDRAULIC PRODUCTION—Look for a considerable advance in developing techniques for hydraulic mining of coal in 1960—flat seams as well as inclined. Some of the future possibilities may be gleaned from the fact that the American Gilsonite Co., which pioneered hydraulic mining in the United States, now is considering working on a vertical face 1,000 ft high, cutting the gilsonite from the top down to the flume at the bottom. As for coal, one of the big problems is water pressure in relation to nozzle wear. If it can be solved—as it should be—it will make hydraulic production much more of a possibility for coal.

AUTOMATED PREPARATION—In this area in 1960 look for a major advance in the use of nucleonic, electronic and other systems to control plant operation and product quality, thus bringing preparation closer to the point of complete automation. And too, in 1960, cleaning of extreme fines by various methods, old and new, will be stressed. And shipping facilities will tend to be less elaborate, with fewer tracks and loading points. Considerable money will be invested in reducing labor in car-handling, with methods ranging all the way from a bicycle or man car for the dropper to rubber-tired pusher-retarder units to escort cars under full control to their destination.

BOREHOLE DEGASIFICATION—Work now completed or in progress quite likely will provide coal with a new tool in battling gas. In other words degasification by borehole looks more promising as time goes on. Both holes drilled ahead of the face underground and also down from the surface in advance of mining are showing real promise, especially if hydraulic pressure is used to fracture the strata and at the same time infuse with water, which also helps with the dust problem.

P. R. AND BLASTING—Anthracite operators are now the targets of a campaign against blasting and other "nuisances" probably unequalled in its history. Bituminous, on the other hand, has not been faced with quite so much hostility, but there is no reason to feel that it can't happen here as well. It, too, should be on the watch for the development of adverse opinion, and in anticipation should exert itself to keep possible nuisances to a minimum and at the same time keep the neighboring public informed. This will not necessarily head off rough times, but they should be less frequent and less severe.

P. R. AND CLEAN STREAMS—Jan. 13-14 this year were the dates of the 46th meeting of the Ohio River Valley Water Sanitation Commission. Its mine-drainage control proposal was the No. 8 topic at the general session. As a result of previous proceedings before the ORSANCO Engineering Committee, Resolution No. 60, with a few amendments to bring it more into line with coal-industry thinking, was quickly passed. Consequently, coal now has an "Acid Mine-Drainage Control Measure" setting standards to which it will be expected to work. The standards are reasonable and so is the commission's attitude. But it could change if there is little or no progress.

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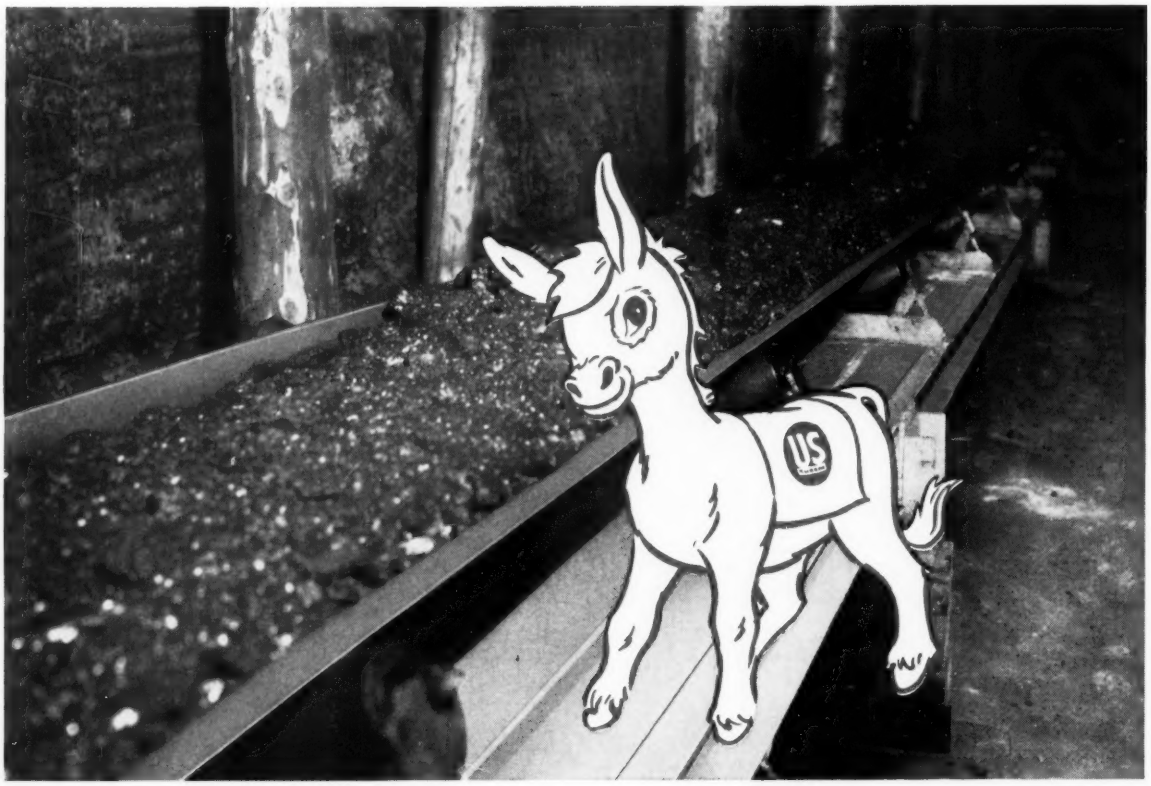

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The Coal Commentator

Tomorrow's Mine Force

Forecasting the future trend of coal production is one of those games in the deadly-serious category, since a hit means a better opportunity to plan and a wide miss may mean extra expense or an opportunity lost. For example, how many men will the industry need, say, 5 yr from now? Or 10 yr?

In 1959 bituminous mines had less than 200,000 men at work for a production of 410 million. If output rises at a rate of 5% a year, which is a not unreasonable figure, production in 1965 could be 550 to 575 million. Would the industry need more men . . . the same . . . or fewer? Assuming tonnage growth at this rate, the answer will turn largely on how much productivity can be increased. In recent years the rate has been over 5% and as high as 10. Improvements in equipment and techniques indicate no decline from these figures in the next few years.

Summing up, bituminous will be producing a lot more coal in the next few years with probably no more men than at present—perhaps fewer. Their duties will be more operation and maintenance—and they undoubtedly will be earning considerably more.

David Ingle

"We regret to announce that Mr. David Ingle, a founder of the company and our senior director in years of service, has announced his retirement as a director at the end of 1959."

This sentence, in the 1959 annual report of the Joy Mfg. Co., reminds one once again of the mutually profitable relationships between manufacturer and miner that have marked the coal industry throughout its history. The Ingle-Joy relationship was, in fact, a real partnership, and was marked, in its early days, by location of the Joy plant at Evansville, Ind., the seat of the Ingle operations. But Mr. Ingle has more than a financial partnership to his credit. Along with other contributions, he was the first to operate 100% with loading machines (1922) and the first to double-shift such machines (1925).

Over the years these and other steps to advance efficiency and promote the interests of coal not only in his own state but nationally have made him one of the outstanding men in industry history, while his friendly, human approach has endeared him to all that have ever known him.

Strata Control

May 16-20 are the dates and Paris (France) is the place. The event? The International Conference on Strata Control, being organized by the Centre d'Etudes et Recherches des Charbonnages de France (CERCHAR).

Papers are solicited. For specifications, write CERCHAR at 35, rue Saint-Dominique, Paris (7e). Sessions will be held at the Centre Marcellin-Berthelot (Maison de la Chimie), 28, rue Saint-Dominique.

Though there are others, strata control is one of the major problems yet to be fully solved in mining. This international conference, plus other measures throughout the world, should lead to major improvements in the art. When these are attained, the road will be cleared for a major step forward, not only in safety but in efficiency.

Still Rising

Among other events in 1959, the average value of natural gas at the well exceeded 12c per thousand for the first time. Coal prices, in contrast, dropped slightly, as did the price of domestically produced crude.

The fact that the wellhead value increased only nominally, though it did break the 12c ceiling, is by no means an indication of the stresses and strains developing over gas pricing. The year 1959 was marked by a major increase in governmental efforts to keep gas prices from skyrocketing, including even court decisions that prices in contracts for supplies for new pipelines were too high and should be cut to a lower figure.

Perhaps the courts and the regulating authorities, with supplies from Canada, can keep the lid on. **More likely, about all that will be possible will be slowing down the rise, because rise there inevitably will be, and coal will be the chief beneficiary, with oil next in line.**

Enough?

Somewhere along the line recently someone asked: How does the firefighting system at the average mine compare with that in the average factory?

A mine fire today can't snuff out as many lives as many past fires simply because the number of men exposed at any one time is less. But a fire still can kill everyone in an underground mine—an eventuality no one likes to contemplate. And fires mean more in property and business losses than they used to.

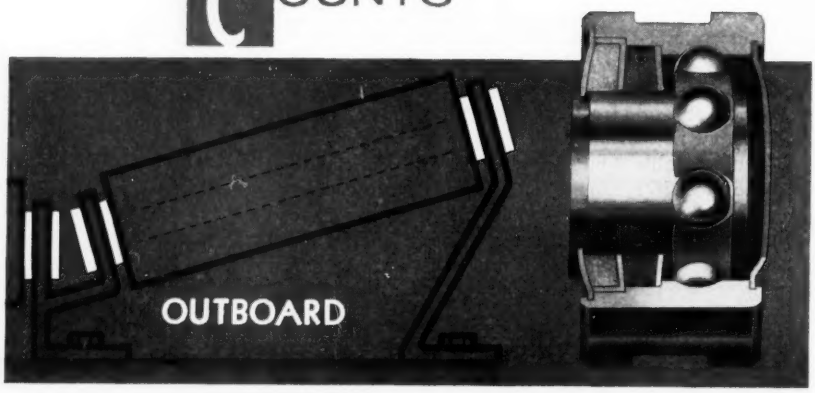
Prevention starts with a resolve to take the necessary measures based on a realistic analysis of hazards and methods of coping with them. Result No. 1 is an awareness of possible hazards that automatically leads to their reduction or elimination. No. 2 is a firefighting system adequate to handle any ignition that might occur. No. 3 is a working force that knows what to do if fire does break out. These are the surest guarantee that fire will not take lives or destroy property.

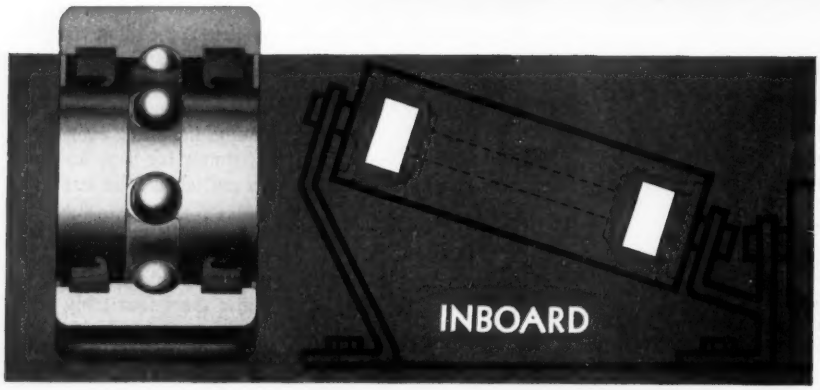
IN *Conveyor Roll* BALL BEARINGS

MARLIN-ROCKWELL RELIABILITY COUNTS

MRC CONV-3-SF

Made for simplified mounting bracket with milled slots in outer ring. Metal shield is backed by impregnated felt and a spring controlled cork seal, assuring long life without relubrication while providing a very effective seal. All exposed surfaces are plated for resistance to corrosion.



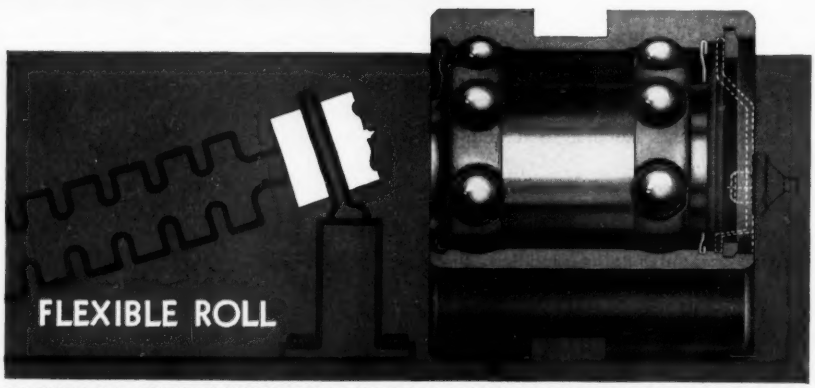


MRC CONV-3-J

Designed for mounting directly into roller. Equipped with positive contact oil resistant synthetic rubber seals, which retain lubricant for life of bearing and protect against entrance of dust and other foreign matter. The sealed-for-life feature of these bearings cuts both maintenance and construction costs.

MRC CONV-4E-2

A double-row inverted contact angle bearing for more internal rigidity which insures alignment of seals and sealing surfaces. It is prelubricated and equipped with MRC Synthe-Seal® on inboard face. Provision is made for end cap, furnished by customer on outboard face, when relubrication is demanded by severity of environment.



BACKED BY 62 YEARS EXPERIENCE IN THE MANUFACTURE OF BALL BEARINGS

Send for Form 1429 MRC Conveyor Roll Ball Bearings

MRC BALL AND ROLLER *bearings*

MARLIN-ROCKWELL CORPORATION

JAMESTOWN, NEW YORK

The Guillotine Test Proves—

HDNF

(Heavy Duty Nylon Fill)

CONVEYOR BELT FABRIC

—has more than twice the impact resistance

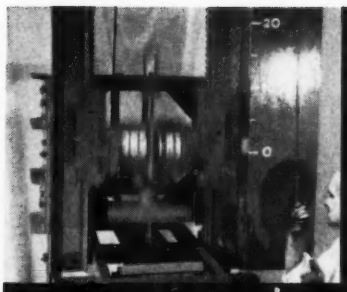
As you can see in the pictures, the crashing blow of the test lab's guillotine couldn't even bruise a sample of HDNF. Never before have the G.T.M.—Goodyear Technical Man—and his colleagues developed a fabric for coal belts with such built-in impact resistance.

Its rip-resistance, too, is unsurpassed. Fastener pull-out strength is 10% to 15% above normal. Its special, balanced weave means good load support.

Yet with this incredible toughness, HDNF gives you excellent troughability. Its thinner-gauge plies pay off in better-than-ever flex-life. And HDNF is, of course, mildew-inhibited – the better to serve in the dampest mines.

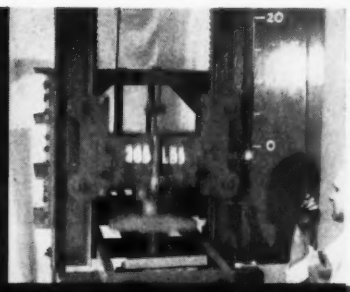
This new kind of belting can very well be the answer to your tough underground needs. Why not check with the G.T.M.—through your Goodyear Distributor or by writing Goodyear, Industrial Products Division, Akron 16, Ohio.

IT'S SMART TO DO BUSINESS *with your Goodyear Distributor. He can give you fast, dependable service on Hose, V-Belts, Flat Belts and many other industrial rubber and nonrubber supplies. Look for him in the Yellow Pages under "Rubber Goods" or "Rubber Products."*



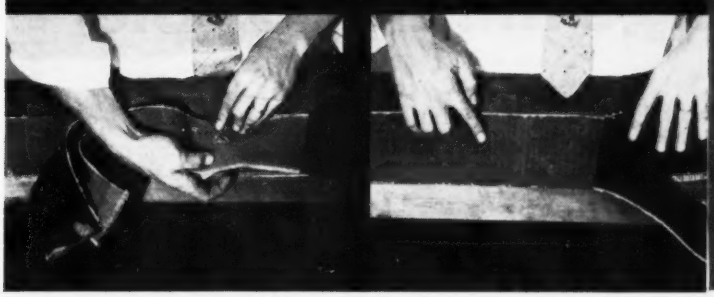
The split second before the guillotine strikes conventional belting a 5,300 in.-lb. blow

Result: 3 plies broken in the conventional belting



The moment of impact—a 10,600 in.-lb. blow crashes into the HDNF sample

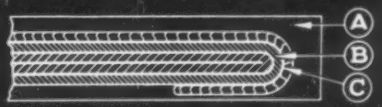
Result: not even a mark on the sample of HDNF



GOODYEAR INDUSTRIAL PRODUCTS

GPI-Specified

HDNF Conveyor Belting Fabric for severe service



A Thick, tough, high-tensile-strength rubber cover for exceptional resistance to abrasion

B Special weave of heavy-duty cotton and nylon fill yarns for excellent resistance to impact and ripping

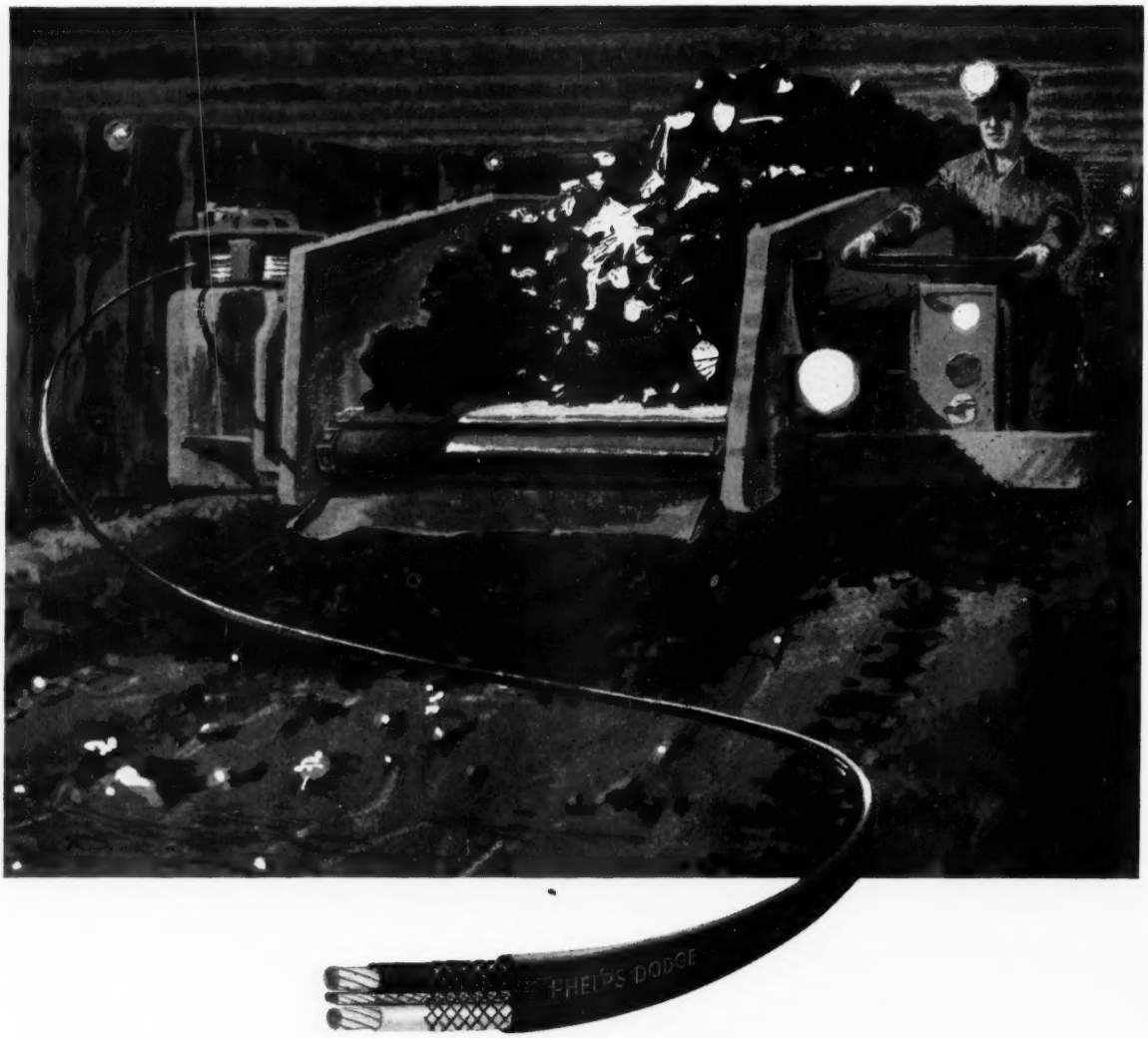
C Skim coat of rubber for added flex-life

CONVEYOR BELTS BY

GOODYEAR

THE GREATEST NAME IN RUBBER

SELECT THE CABLE MADE BY THE FAMOUS "MINE-TO-MARKET" FAMILY . . .



Phelps Dodge Mining Cable

- Made of highest quality copper from Phelps Dodge's own open-pit mines.
- Combines years of Phelps Dodge mining "know-how" with many years of cable manufacturing experience to give you the finest quality cable you can specify.
- Assures utmost protection against damage from mechanical and electrical hazards in both above and below ground mining operations.
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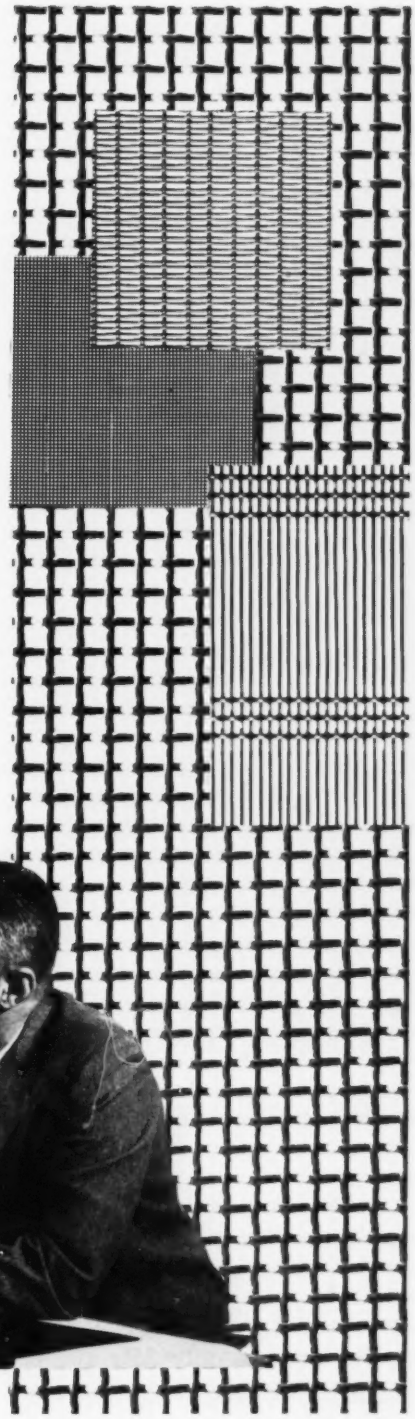
PD

TYLER service offers 53,000 ways to cut screening costs

To meet all the different requirements for sizing, grading, and separating materials, W. S. Tyler has developed wire cloth in innumerable types, sizes, metals, meshes, and designs. Today, over 53,000 different specifications are available.

Matching the *right* wire cloth to your specific needs is the service provided by your Tyler sales engineer. From Tyler's unequalled range of product he has the know-how and experience to give you results.

That's *Tyler Screening Service*—use it to cut your production costs.



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HIGH PERFORMANCE

200% more tonnage per man as JEFFREY 86-A Colmol works in 36" seam

Production of 860 tons of raw coal per shift has been attained, with consistent performance, giving better than 90 tons per face man over a three-month period.

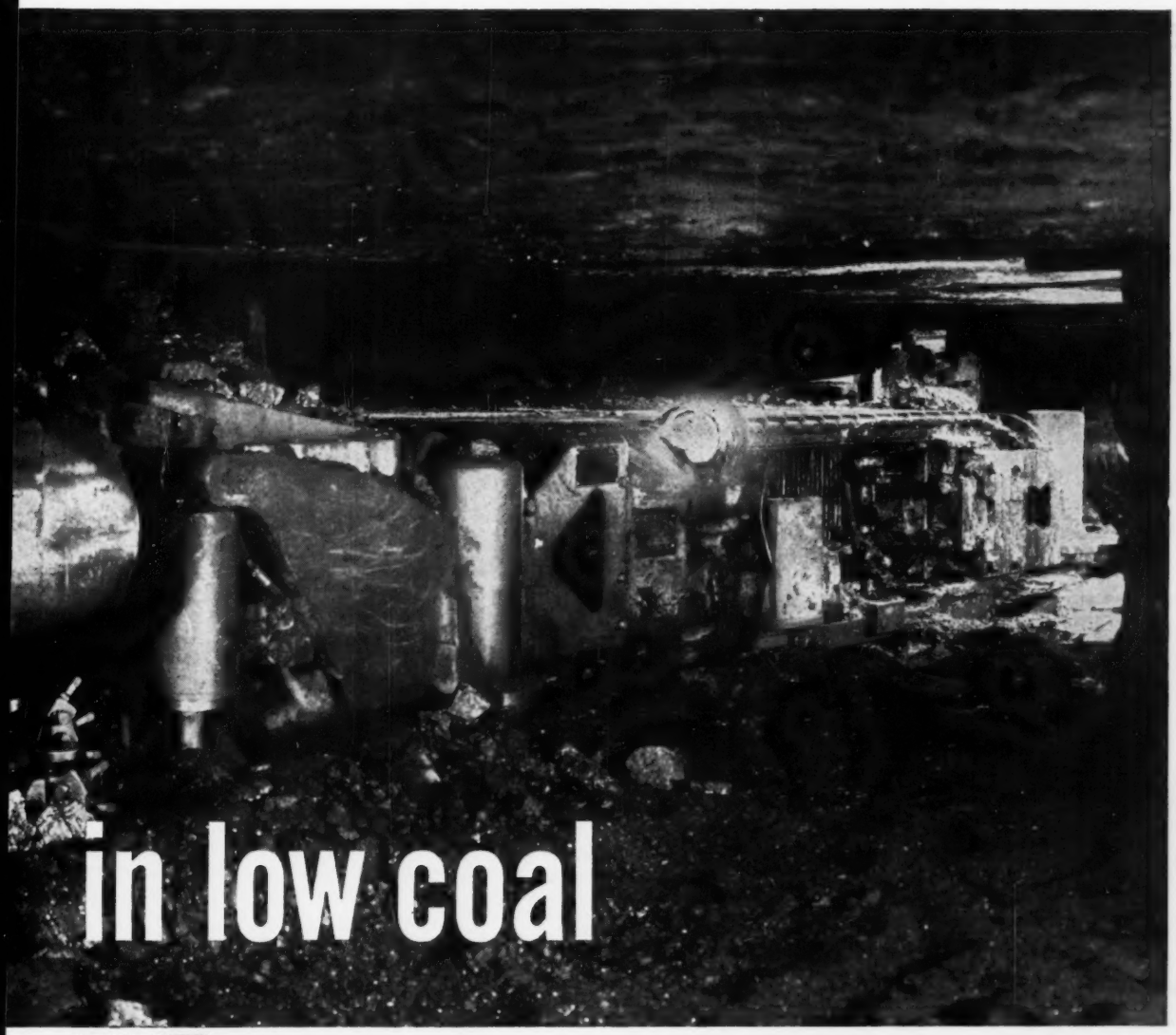
The 86-A is only 25¼ inches high, makes a cut 14' 7" wide, is ideal for low seams 28" to 44" in height. All adjustments are hydraulic, and can be made quickly and accurately. Easy maneuvering contributes to the Colmol's high performance.

To move your costs down—productivity up—get Jeffrey's *system engineering* recommendations . . . covering equipment for mining and hauling or conveying. A system engineered job pays off in predictable results!

The Jeffrey Manufacturing Company, 912 North Fourth Street, Columbus 16, Ohio.

CONSISTENT PERFORMANCE WITH COLMOL IN THREE-MONTH PERIOD

No. Shifts	Tonnage	Tons/shift	Tons/man
79	43,450	550	91.3



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EQUIPMENT...TRANSMISSION MACHINERY...
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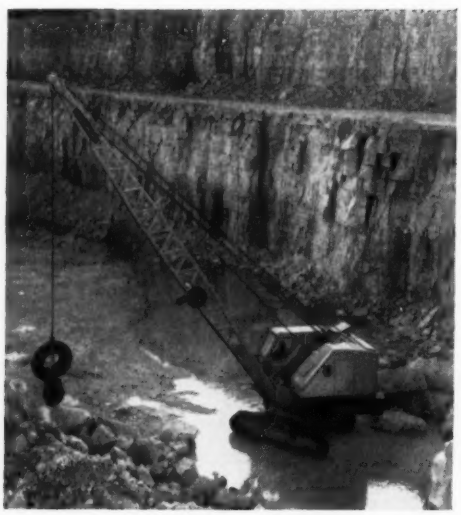
Keep your eye on KOEHRING WORK CAPACITY

A heavy-duty team —
Owner of this limestone quarry has standardized on Koehring® equipment for both excavating *and* hauling. Blasted rock is loaded out by 1-yard 405 shovel —and hauled to crusher in 6-yd. Koehring Dumptors.

Loading RR cars —
stockpiling, lifting 22-ton crusher into place, erecting plant, feeding hoppers in the pit — busy Koehring 805 is a jack-of-all-trades around this gravel plant. Capacities: 2 to 3-yard clamshell or dragline, 52-ton lift crane — converts to 2-yard shovel.



Rock-buster —
Swinging a skull-cracker in stone quarry, a 15-ton 305 crane pulverizes oversize slabs and chunks of blasted rock. A popular size in mines, quarries, the 305 is available on 3 types of mountings: crawlers, truck, self-propelled Cruiser®.

High-lift stripper —
at this coal mine has 1½ yd. dipper on 28-ft. high-lift boom. Work range: 34 ft.-4 in. cutting height and 25-ft.-9 in. dumping height at 45° boom angle. It's a Koehring 605. Also available with 1½-yd. dipper on standard 22-ft. heavy-rock shovel boom.

Deep-pit specialist
This high-lift 1205 puts deep stripping on a long-reach basis: 51 ft.-4 in. cutting height with 2½-yd. dipper on 50-ft. boom (at 45° angle). Or, with 3-yd. dipper on 40-ft. high-lift boom, big Koehring 1205 cuts bank face at heights up to 42 ft.-10 inches.

Plenty of pick-up —
Unloading and installing heavy, bulky machinery is no problem with a Koehring 545 truck crane on hand. How much will it lift? Up to 45 tons, with 40-foot boom at 15-foot radius!

Stripping 30 feet of overburden from coal deposits, Koehring 1205 dragline swings big bucket over a wide work radius. Bucket sizes on the big 1205 range from 3 to 4 yards — and boom lengths from 60 to 170 feet, depending on weight of materials. Yet, operator handles it with light lever-pull (90% power-assist on main drum clutches). Retains sensitive "feel" of load. 360° full-revolving fairlead maintains true cable lead at any pull angle on bucket. 1205 converts to clamshell, 95-ton crane, 3-yard shovel (standard or high-lift). Call your Koehring distributor for complete details on this, and all other sizes.

KOEHRING
DIVISION OF KOEHRING COMPANY
Milwaukee 16, Wisconsin

Koehring excavators, cranes also manufactured in:
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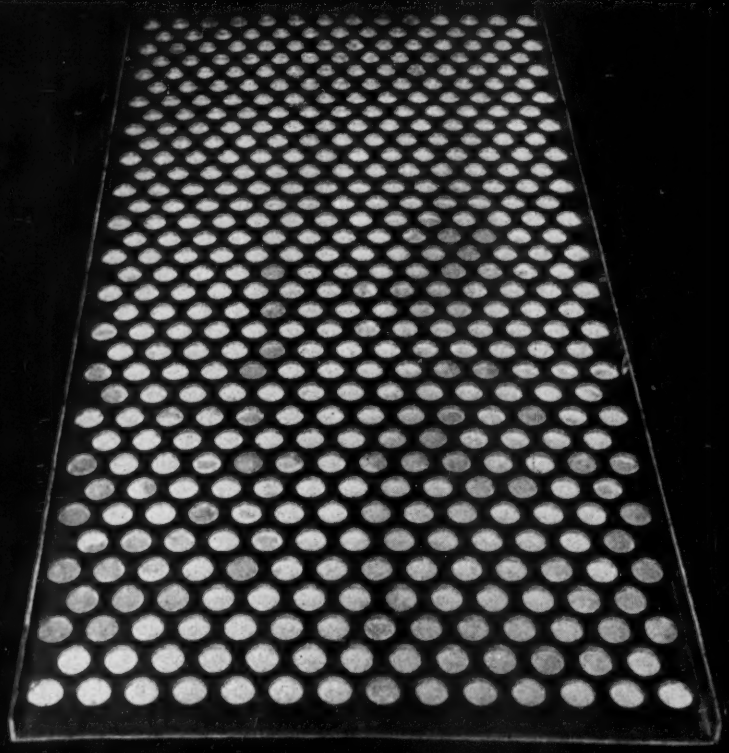
SKOOPER solves split coal vein problem — In this Iowa coal mining operation, top seam of good quality bituminous coal was separated from bottom seam by a 2-inch layer of fire clay. Conventional shovel loaders mixed clay in with coal, causing too high an ash content. Solution: Koehring 205 Skooper! Its 7-foot level crowd took off the top coal seam clean, fast, without mixing in clay. No ground-grinding, skid-turn action of tractor loaders either, because full revolving Skooper swings through complete loading cycles without track movement. *There's nothing like it on wheels or tracks!*

KOEHRING SKOOPER



DON'T LET VIBRATING SCREENS DRAIN AWAY YOUR PROFITS

use

HENDRICK H QUALITY STEEL

The quality of the perforated plate you use in vibrating screens can make the difference between profit and loss in mineral preparation. That's why it's a smart idea to use Hendrick H Quality Steel Perforated Plate.

This plate stands up under continuous, heavy-duty operation. It screens coal easier, faster. Full clearance practically eliminates blinding. Deck changes are fast, permitting savings in labor costs. Large open area offers maximum protection.

Hendrick H Quality Steel Perforated Plate is made from high carbon or stainless steels, carefully developed by Hendrick after many years of experience. It is available either flat, corrugated or stepped, in any desired shape, and with perforations of any size. Write for information on the type of H Quality Perforated Plate that will best fit *your* operation.

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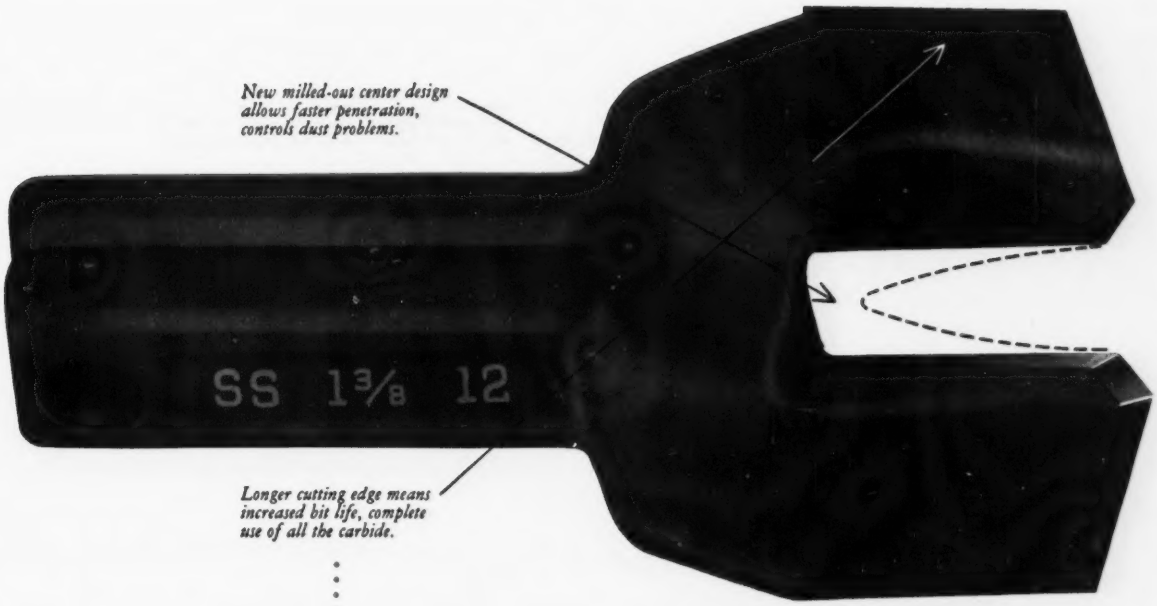
41 DUNDAFF STREET, CARBONDALE, PA.

PERFORATED METAL • PERFORATED METAL SCREENS • WEDGE-SLOT SCREENS • HENDRICK WEDGE WIRE SCREENS • ARCHITECTURAL GRILLES • MITCO OPEN STEEL FLOORING – SHUR-SITE TREADS • ARMORGRIDS • HYDRO DEHAZERS • DISTILLATION COLUMN INTERNALS.


New milled-out center design allows faster penetration, controls dust problems.
SS 1⅜ 12
Longer cutting edge means increased bit life, complete use of all the carbide.

Carmet SS Style Roof Bolting Drill Bit

FREE-FLOWING BIT DESIGN CUTS ROOF HOLE DRILLING TIME 25 PERCENT

The outstanding performance of Carmet's Style SS roof drill bit has been proven over the years in tests and under actual operating conditions in mines throughout the country. This sturdy mining bit consistently drilled faster, cleaner and more accurately than others on the market.

Now, the newly modified milled-out center design of the SS Bit allows freer passage of large cuttings for even greater drilling speeds. It can save you up to 25 percent drilling time. The problem of dust control at the face is practically eliminated.

The harder, more wear-resistant Carmet Carbide grades used on all Carmet mining tools guarantee a longer operating life for the SS Bit and greater economy of operation for you. Heavy alloy steel support under the cutting tip insures against carbide fracture and strong prongs insure against tool breakage. SS Bits are available in the following sizes: 1⅜, 1⅞, 1½, 1⅝, 1¾ and 1⅞.

See your Carmet Distributor today for more information on the SS Style Roof Bolting Drill Bit . . . and also, ask him about Carmet's complete line of mining tool bits.

WSW 7182

NEW CARMET MINING TOOL CATALOG NOW AVAILABLE FROM YOUR CARMET DISTRIBUTOR

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The newly revised 5th Edition of the Carmet Mining Tool Catalog contains application data and specifications on the complete line of Carmet Mining Tools, including a complete section on grinding and reconditioning. For your copy, write Carmet Division, Allegheny Ludlum Steel Corporation, Detroit 20, Michigan.

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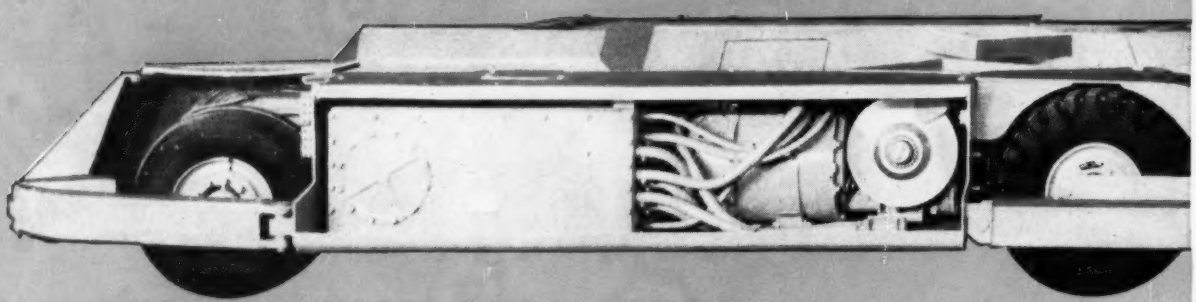
The Original DOUBLE-BONDED Carbide Cutter Bit

CARMET AL

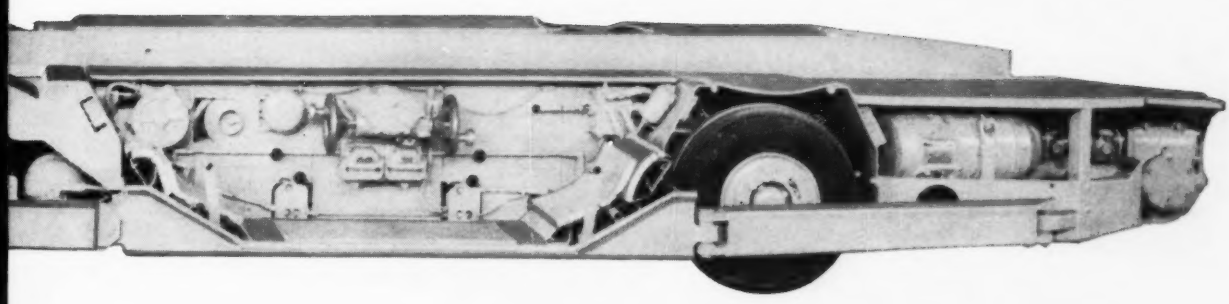
Faster Trip Time . . . Better Haulage

with JOY 18-SC



Shuttle Cars

18-SC Shuttle Cars are flexible and easy to maneuver. Wheel unit maintenance has been reduced to a minimum by eliminating gears.



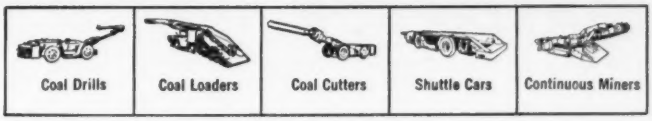
Joy's revolutionary six-wheeled 18-SC Shuttle Cars use two wheels for traction and four for steering. They have proven underground that they increase haulage efficiency. Faster trip times, plus capacity up to 50% greater than competitive cars, have resulted in substantially greater tonnage per shift.

Trip time is improved because operators find that they can tram at top speed from face to discharge point in safety and comfort. The hinged-center design enables the cars to follow the bottom, improving traction and eliminating the danger of "roofing." The hinged-center also eliminates the need for an elevating discharge conveyor, since the 18-SC's can run right up a ramp and discharge directly on to the belt. A hydraulic traction-booster can be engaged for extra traction in bad bottom and on grades. The straight-through conveyor unloads the 18-SC Shuttle Cars in thirty seconds or less, to further cut trip time.

18-SC Shuttle Cars are available in 27″, 32″ and 40″ heights, and in various widths, to suit mining conditions. Consult your Joy representative for full information on how these 18-SC cars can cut your haulage costs.

WORLD'S LARGEST MANUFACTURER OF UNDERGROUND MINING MACHINERY

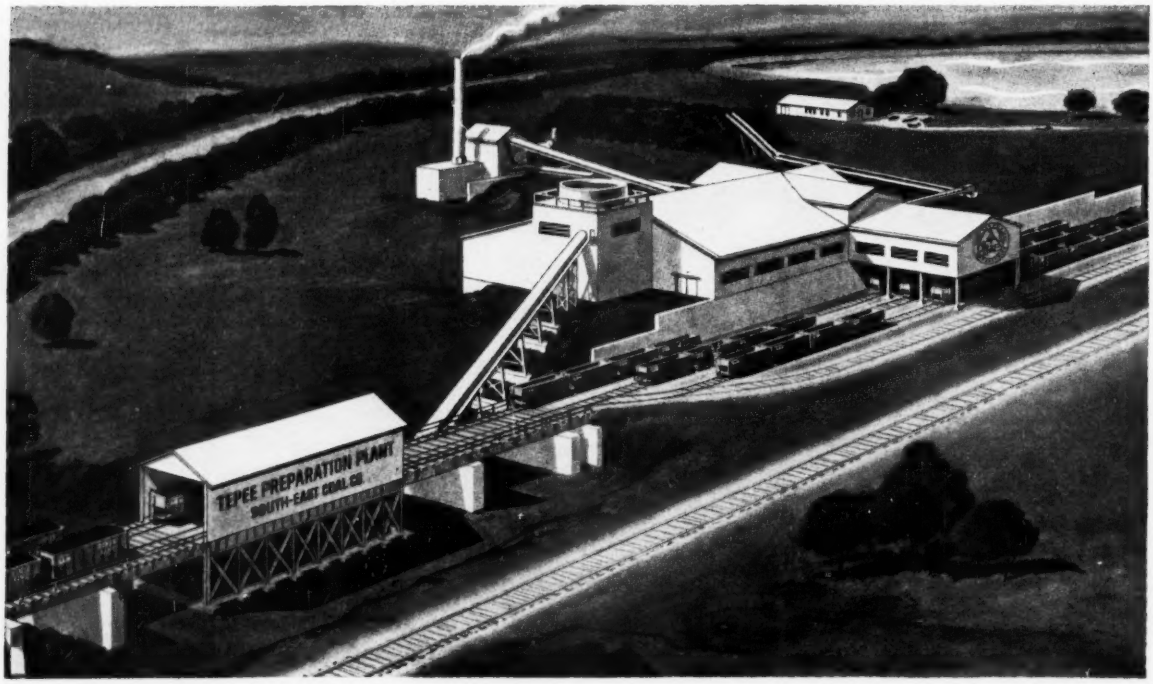
JOY



Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

a new concept in COAL PREPARATION PLANT DESIGN



Artist's view of the new 900 TPH Coal Preparation Plant for South-East Coal Company, Irvine, Kentucky

In close cooperation with the Kentucky Engineering and Materials Company, prime contractors for the South-East Coal Company, Heyl & Patterson is executing plant lay-out and design engineering for the Fine Coal Preparation and Water Clarification Plants, based on H & P's flow sheets.

Heyl & Patterson was entrusted with this role on the strength of its pioneering in new and improved coal preparation methods and because it has developed the equipment necessary for these better practices.

The unique split-level design of South-East Coal Company's new coal preparation plant utilizes the topography to achieve substantial savings in excavation and foundation costs.

When it is completed, this plant will process 900 TPH of 6" x 0 coal with equipment selected for economy and performance. Much of this equipment is the product of Heyl & Patterson's research program for the development of advanced coal preparation machinery and processes. For instance, the H & P Fluid Bed Dryer in this installation is the largest single unit thermal dryer ever built.

Discuss your new coal preparation requirements with H & P engineers who will gladly assist in an earnest search for solutions best suited to your own operating and marketing conditions.

Depending on your needs, you will receive from us a proposal either for a "turn-key" job or a cooperative effort, similar to the one proving so successful for the South-East Coal Co.

When experience counts . . . count on Heyl & Patterson.

HEYL & PATTERSON, inc.

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H&P

EXTRA RUGGEDNESS . . .

FOR MARION 151-M SHOVEL

WITH WICHITA CLUTCH FOR CROWD

Wichita Clutch protects gears and shafting under heavy duty digging conditions for this popular Marion Electric Shovel

To help provide profitable yardage in continuous heavy duty service in mining, quarrying and slag handling, Marion has standardized upon dependable Wichita Air-Tube Clutches.

Main advantage here in *controlled slipping torque* easily adjusted by a hand valve convenient to operator. Clutch is ideal *safety device* for protection of gears and shafting during the high impact loads created by hard digging.

Typical of Wichita acceptance by Marion customers is the order from one mining company for nine Wichita Clutches for older machines in their mines.

For any tough clutching or braking problem consult Wichita engineers . . . experienced in the most difficult applications in every industrial application.

Contact your nearest Wichita Engineer.

Clutch & Control Engineering Co., Livonia, Mich.
L. H. Fremont, Cincinnati, Ohio
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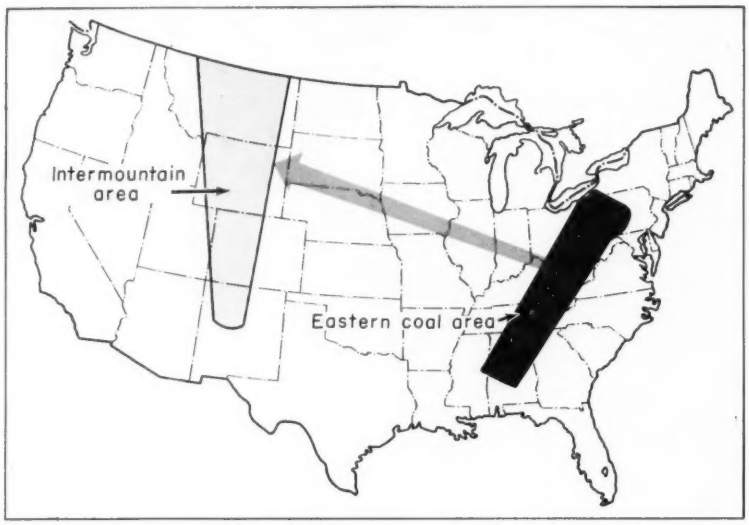
Dominion Power Press Equipment, Ltd., Burlington, Ontario, Canada
R. E. Kunz, Seattle 4, Wash.
Norman Rupp Co., Portland 4, Ore.
Bates Sales Co., St. Louis 1, Mo.

WICHITA Clutch COMPANY, INC.
WICHITA FALLS, TEXAS, U.S.A.

News Roundup



INTERMOUNTAIN manufacturing plants, needing coke for chemical and steel making, may not have to haul it (arrow) from the East any more if new chemical processes prove economical for conversion of local sub-bituminous to quality coke.

Advances in coal-to-coke technology with low-rank bituminous may provide . . .

New Opportunities for Western Coals

Two unique chemical processes for producing, economically, metallurgical-grade coke from vast coal reserves in Utah-Wyoming Intermountain area, are announced.

WESTERN soft coal producers' hopes for new growth got a boost, just before 1959 bowed out, when two large industrial firms announced development of processes for conversion of Intermountain area coal, considered unsuitable for conventional coking techniques, to metallurgical-grade coke.

United States Fuel Co., subsidiary of United States Smelting, Refining & Mining Co., revealed it had perfected, on pilot plant basis, commercial reduction of Utah sub-bituminous to high-quality coke pellets and coal-chemicals, and that it had applied for patents on the process.

Shortly, thereafter, Food Machinery & Chemical Corp. reported it would start, almost immediately, construction of a $3½ million plant at Kemmerer, Wyo., to manufacture coke for its phosphorus operations at its WestVaco Mineral Products Div., in Pocatello, Ida. A spokesman for the firm said the plant would employ a revolutionary new process.

Intermountain coal producers are, naturally, rooting for the projects' success. Most of the carbon-consuming process plants, have until now, depended on coke hauled from Kentucky and West Virginia. If western coal is demonstrated to be economically adaptable to coking techniques, savings on shipping costs would probably encourage development of more carbonizing processes in the area.

U. S. Fuel—Basic to U. S. Fuel's new process is the formation of a soft-coal pellet through use of an inert binder and the burning of natural gas within coke conversion chambers as an auxiliary supply of carbon. Disintegration of the pellets, which would result if coal solids had to supply all the carbon for the reduction reactions, is thus prevented.

In steps, the process runs as follows. Soft coal fines or breeze are united with water and the binder. This material is pelletized in a revolving drum. It is then screened to size, the rejects going back to the drum. After sizing, the pellets are dried by waste heat from the coking unit.

From the hopper the pellets travel to a preheating chamber where natural gas heat is applied to bring temperatures from ambient level to 300 C. The pellets move to a retort where natural gas, blown up from the bottom of the coking unit, is ignited and decomposed at about 1,220 C. Natural gas carbons unite with soft coal elements, forming a hard coke pellet.

Coke produced by the pilot unit ranges in size from 7/16 to ⅞ in, reports U. S. Fuel. Volatile content of the coke is less than 1% (compared with 40-45% in the raw coal), sulfur runs 0.5 to 0.6%, and ash content is about 10%. The process yields by-product coal oils and tars as do conventional coking processes. Reactor gas contains as much as 85% hydrogen, which, U. S. Fuel engineers believe, can be used to hydrogenate coal oils to produce automotive-grade gasoline.

The company will build a $250,000, 50-ton-a-day unit which will produce enough coke for operational experiments in phosphorus furnaces and the steel industry. The firm believes a commercial-

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Utilization ..... p 66

There's a reason WHY in MacWHYte Wire Rope*

It brings out the best in your equipment!

Just as you use specialized equipment for a particular job, it pays to use the right kind of wire rope designed for that equipment.

All wire rope isn't the same. There are changes in the construction of wire rope . . . which aren't obvious to the eye . . . but can seriously affect the way it will work on your equipment. Because all equipment isn't the same, different types of rope are required because of basic design variations.

With this in mind, you can see the reason "why" Macwhyte offers such a wide variety of wire rope:

* Every foot of wire in Whyte Strand is specially drawn, cold-worked by Macwhyte in their own wire mill. Complete processes — from raw material to finished wire for rope — are under the watchful eyes of Macwhyte metallurgists.

* Product engineers determine the exact number, size, and relationship of the wires needed to meet the requirements of your equipment. You're sure of the correct size, strength, and flexibility.

* Special lubrication is available in accordance with the needs of the equipment or the type of service in which the rope will be used. The tenacious lubricants provide just the necessary protection — are unaffected by heat or cold, dry or wet conditions.

* Entire wire and rope mill operations are concentrated on the making of wire rope in a thousand and one sizes, grades, and types . . . to give you the rope you need.

Result: Whyte Strand wire rope is literally "custom made" for strip shovels, loading shovels, draglines, shaft hoists, haulage, underground scrapers, loaders, mining machines, conveyors, car pullers, and blast hole drills. Ask for new bulletin 6025 giving complete listings of Whyte Strand wire rope. 207

MACWHYTE Wire Rope COMPANY

2900 Fourteenth Avenue, Kenosha, Wisconsin, U. S. A.

size unit serving the Intermountain area's phosphorous industry would cost about $2 million, producing 100,000 tons of coke annually at a substantially cheaper price than what elemental producers pay for eastern coke.

FMC's Technique—Food Machinery & Chemical Co.'s process, which had not been fully revealed as we went to press, is believed to be a two-step process of reduction. The coals are placed in a retort or preheat preparation chamber and are reduced to a friable semi-coke. This semi-coke is briquetted mechanically without a binder and recharged to a coke-reducing element. Natural gas is used only as a start-up aid. Henry Messman, New York manager of FMC's carbon project, says this coke can be produced in ⅞-in sizes for the elemental trade. The FMC process is applicable to steel blast furnace use, adds Mr. Messman, and for this purpose the coke can be produced to 3-in diameter.

In contrast to conventional coking methods, FMC's process does not produce any by-product coal tars, oils or coal gases. FMC maintains that this is a "virtue" cost-wise, but many coal chemical trade people believe that some coking costs must be borne by by-products to make metallurgical-grade coke competitive.

Joint Venture

Peabody Coal Co. and Curtiss-Wright Corp. have formed a new company, Peabody-Wright Corp., to produce a variety of products using bituminous coal; these will include chemical coke, heat, low-temperature coal tars and coal-based paving binder.

The new firm plans, at first, to build and operate a small commercial plant for the application of a Peabody-developed carbonization system known as the Mansfield Process. This method, yielding chemical coke and low-temperature volatile gases, will be combined with the Curtiss-Wright process for recovery of low-temperature coal tar from volatile gases and production of coal-based paving binder for roads and airport runways.

Curtiss-Wright announced last April the development of an improved paving binder using high- or low-temperature coal tars with digested coal for hot-mix, hot-lay bituminous surfaces. It is believed by the two firms that utilization of the low-temperature volatile gases produced by the Mansfield Process, which Peabody has been developing for 3 yr, will provide an important economic advantage in the paving-binder production.

Ted L. Kelse, executive vice president of Peabody, was elected president of the new firm, which will be headquartered in St. Louis, Mo. Members of the Board of Directors of the new organization are: Roy T. Hurley, chairman and president, Curtiss-Wright; F. Stillman Elfred, chairman of the board, Peabody Coal Co.; George R. Hill, executive vice president, Curtiss-Wright; William L. Hanaway, Breed, Abbott & Morgan; and Vaughn Mansfield, chief combustion engineer, Peabody Coal Co.

JOHN L. LEWIS is flanked by waiters bearing cakes noting his 40 yr as head of the United Mine Workers, at a testimonial dinner Jan. 14. Mr. Lewis officially retired but was immediately elected president emeritus, the first time such an honor had been bestowed on anyone by the union.

ORSANCO Curbs Acid Drainage

Under "Resolution No. 60," The Ohio River Valley Water Sanitation Commission adopted acid mine-drainage controls Jan. 14, 1960.

The commission, popularly known as "ORSANCO," is an agency dedicated by Congress-approved compact to control pollution in eight states of the Ohio River Valley—Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia and West Virginia.

The control measures have been under intensive study for over 2 yr by ORSANCO's Engineering Committee and by its Coal Industry Advisory Committee. CIAC, whose members represent companies mining most of the country's bituminous coal, has pledged "whole-hearted support" of the new regulations and will seek their maximum implementation through an industry action program.

The full text of Resolution No. 560 reads as follows:

"WHEREAS: By resolution adopted on the 6th day of April, 1955, the Ohio River Valley Water Sanitation Commission promulgated a statement of policy and procedures for the control of industrial-waste discharges into waters included within its jurisdiction by the terms and provisions of the Ohio River Valley Water Sanitation Compact; and

"WHEREAS: Waters of the Ohio River Valley Water Sanitation District are being polluted by acid discharges from coal mining and related operations, hereinafter referred to as "acid-mine-drainage," contrary to the language and intent of the Ohio River Valley Water

(*Continued on p 58*)

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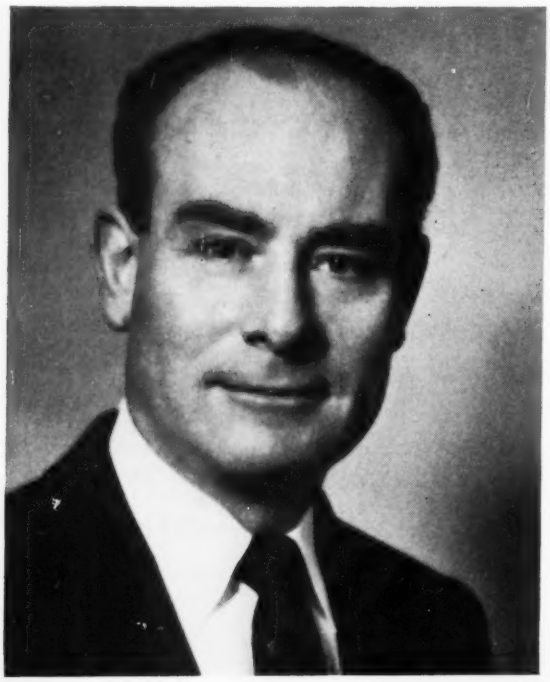
People in Coal



New UMWA Vice President

W. A. (TONY) BOYLE, who has replaced John Kennedy as vice president of the United Mine Workers, was born 56 yr ago in a Montana mining camp to Mr. and Mrs. James P. Boyle.

Mr. Boyle was educated in schools in Montana and Idaho and studied law at LaSalle University. In his career with the union, he has served in various local union offices of the UMW, and in 1940 was elected president of Dist. 27.

While in this capacity, he was appointed CIO regional director for four western states and later served as regional director for Dist. 50 in the same territory. He helped bring the benefits of the union to industries previously unorganized in these states.

During World War II, he represented the union on numerous government and industry committees, manpower councils and War Labor Board panels. When the Unemployment Compensation Commission was established in Montana, the Governor of the state named Mr. Boyle as the first labor representative on the advisory council.

Since 1948, Mr. Boyle has served as assistant to John L. Lewis at International headquarters in Washington, D. C., and has been appointed by Mr. Lewis to represent the union on a number of boards and committees, including the Joint Industry Safety Committee and the Joint Board of Review.

Mr. Boyle and his wife, the former Miss Ethel V. Williams, a school teacher, have a daughter, Antoinette, who is associated in the practice of law in Montana with her husband, Daryl E. Engebregson.

NCA Appoints Three Marketing Dept. Heads

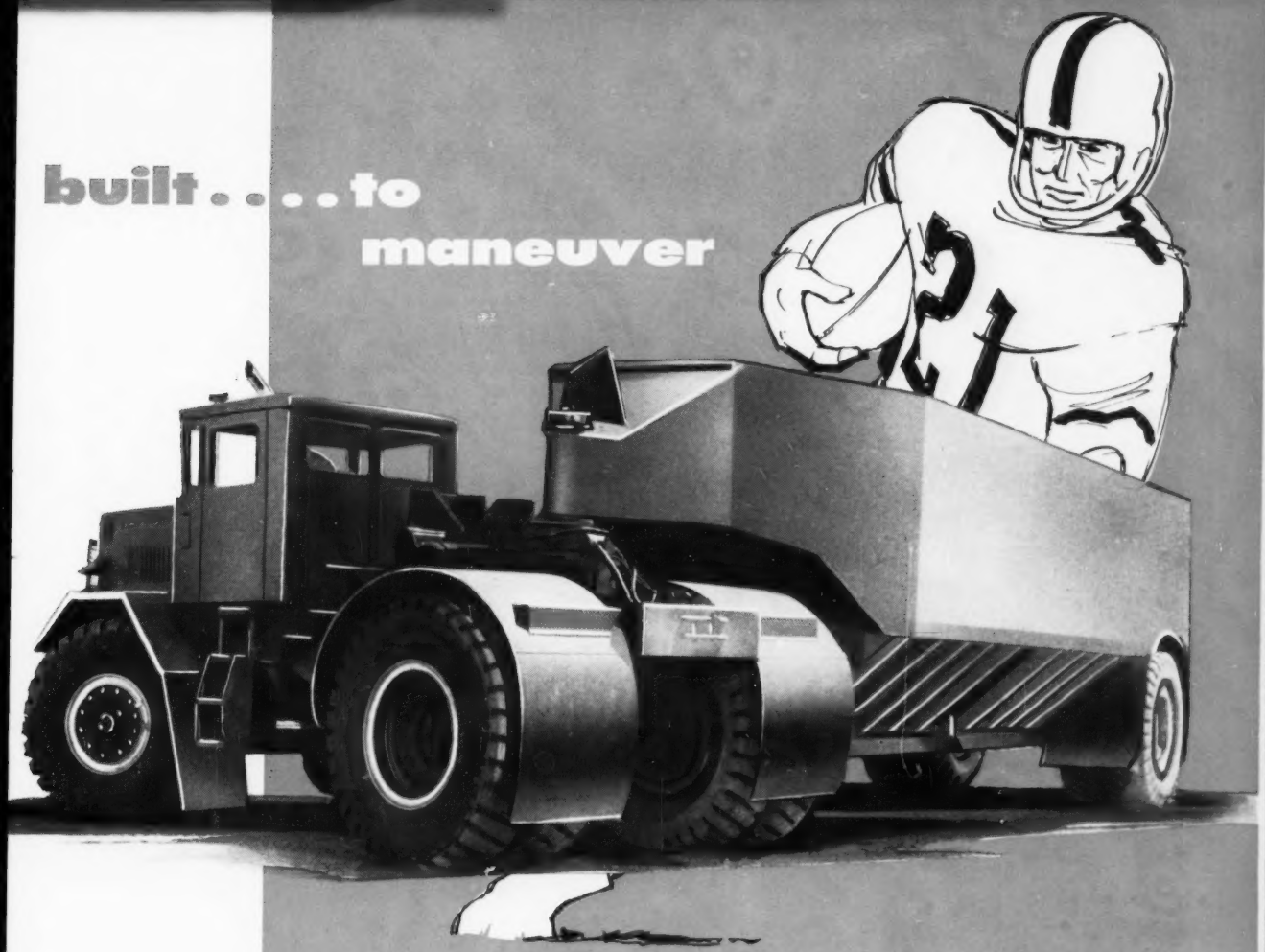
Carroll F. Hardy is the new director of the Bituminous Coal Institute Div. of the National Coal Association. Mr. Hardy, who was managing director of BCI before it merged with NCA, studied engineering at Purdue University. He has served as fuel engineer for Appalachian Coals, Inc., and directed the engineering work of the Coal Producers Committee for Smoke Abatement. In 1955, he became director of the Market Promotion Dept. of NCA, which established a staff of fuel engineers throughout the country to further the use of coal by making sure it was considered in new construction and modernization of existing plants. Mr. Hardy is the author or co-author of some 100 technical articles and pamphlets and holds the honorary degree of Master of Industry from Purdue University.

Paul L. Brown became director of the Manpower Development Div., of NCA. He will initiate, administer and participate in all industry-wide programs previously carried on by the American Coal Sales Association, where he was director of training and education. Mr. Brown, a native of Clarinda, Iowa, received a bachelor's degree from the University of Illinois, a master's degree in marketing from Oklahoma A&M and a Ph.D. in marketing from Ohio State University. He has served as a professor in marketing at the University of North Carolina and Ohio State and is co-author of "Retailing—Principles and Practices."

Harry C. Ballman was named director of the Air Pollution Control Div., of

(*Continued on p 38*)

built . . . . to maneuver



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KW-DART 50S-BDT, 50 ton coal hauler. Mine records prove the unusual economy of this popular model.

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The "Man from McNally"
reports on a record of
outstanding customer servi
that stretches over more
than a third of a century.

"...another new McNally-built Truax-Traer coal preparation plant goes into action"

(The latest of nineteen plants and additions built for this company.)

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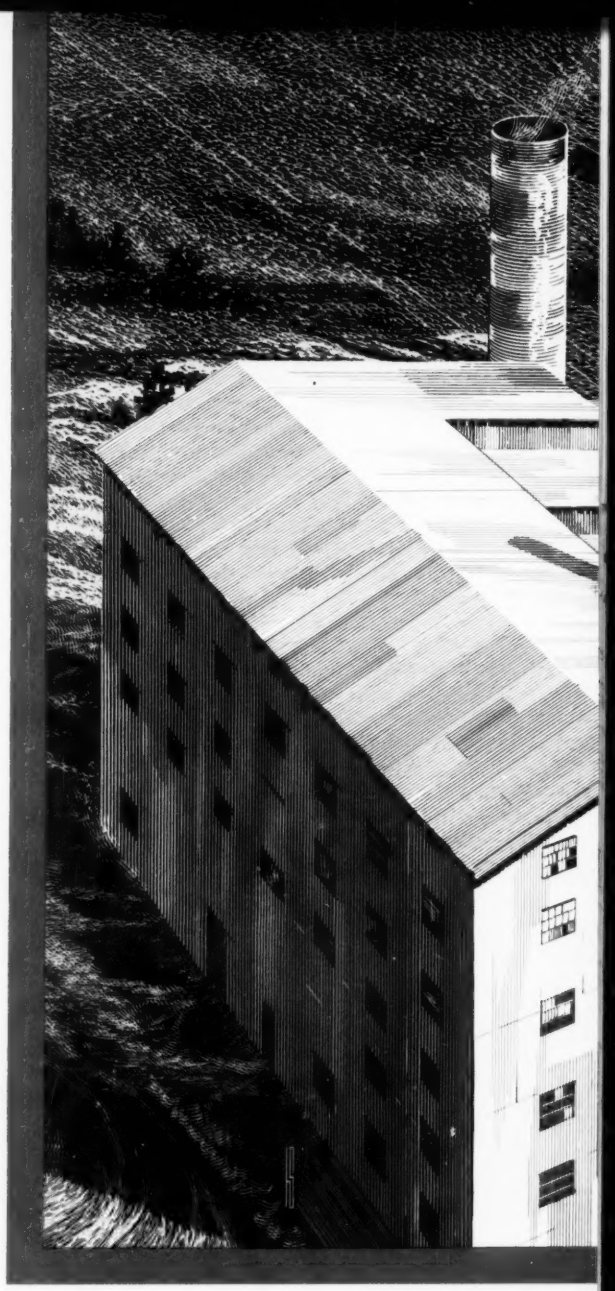
The newest McNally-built Truax-Traer plant at Mine No. 2, Pinckneyville, Illinois, put into production in the record time of 13 months from contract signature, will wash 1000 tons per hour of 3" x 0 coal. R.O.M. feed goes to a 100-ton hopper by truck or rail car. Carried by belt to a 12' Rotary Breaker, the R.O.M. coal is broken to 3" x 0. This through product then goes to a 2500-ton stock pile and by conveyor to feed two Mogul Washers at 1000 tons per hour.

Washed coal goes to four dewatering screens where the 1" x 3/16" and 3/16" x 0 coal is removed—with the 1" x 3/16" coal going to the McNally Vissac Dryers—and the 3" x 0 portion going to two crushers which produce 1" x 3/16" and 3/16" x 0.

The 3/16" x 0 from the dewatering units is pumped to the cyclones—with overflow going to the refuse sump, and underflow going to the desliming screens. Product from the screens goes to the centrifugal dryers—and then to the loading out point. Provision has been made for an automatic sampling system and an oil treatment system at the loading out point.



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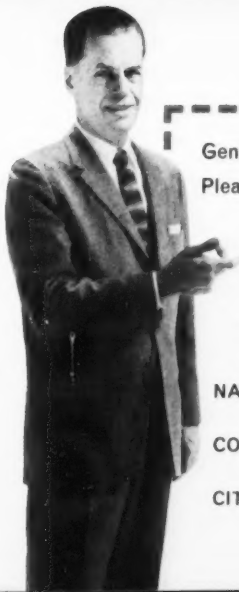

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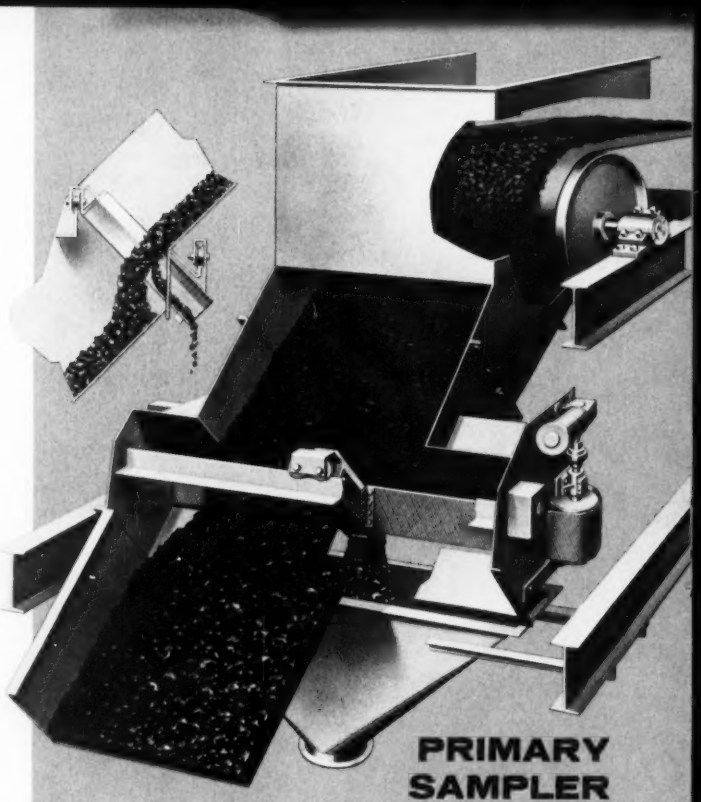
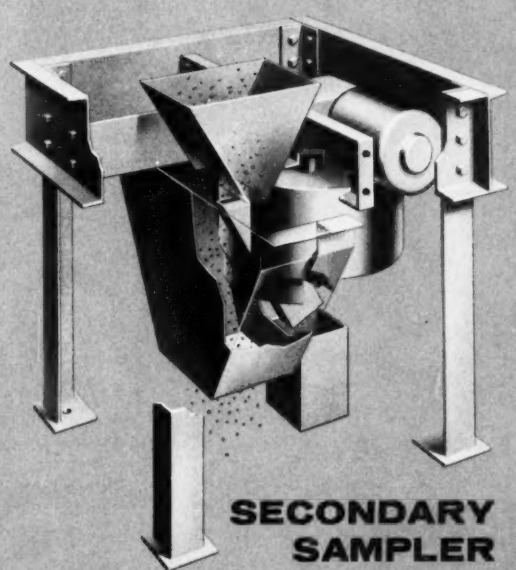
McNally Primary Sampler automatically samples coal stream at intervals of 1 to 30 minutes. Stainless steel cutter travels at uniform rate while passing through coal—largest particles pass freely into sample without segregation of material—giving a true sample each time.

McNally Secondary Sampler runs continuously, taking sample of entire coal stream with revolving stainless steel cutter. Simple in design, easily installed.



PRIMARY SAMPLER



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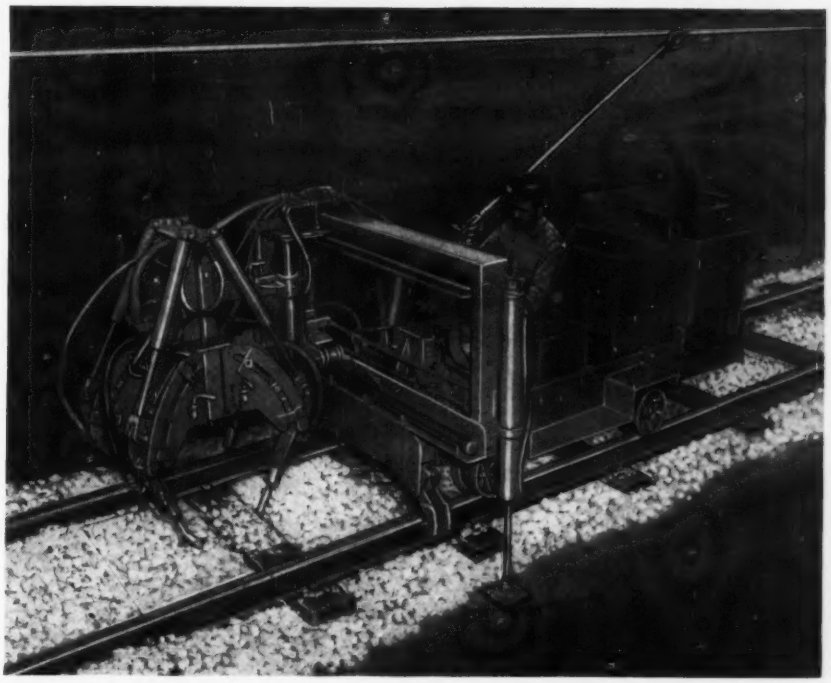

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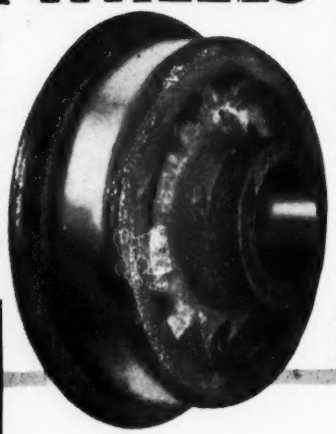

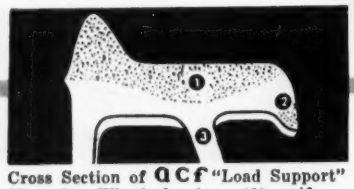

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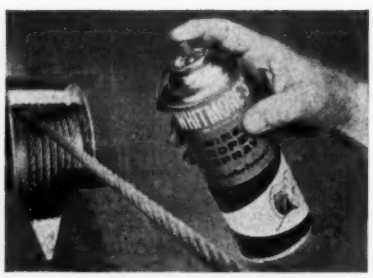

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People in Coal *(Continued)*

NCA. He will work with government agencies, civic organizations and coal industry groups to obtain cleaner air from processes using coal. Mr. Ballman, formerely manager of field engineering services of BCI, is a native of Cincinnati and attended the University of Cincinnati. He served 12 yr as industrial sales engineer for Island Creek Coal Sales Co., and from 1945 to 1947 was responsible for personnel training for the Winkler Stoker Co., of Lebanon, Ind. In April, 1947, Mr. Ballman became assistant to the chief engineer of the air pollution control program of Indianapolis, then spent 1948 as smoke regulation engineer for Richmond, Va. From 1954 to mid-1957 he was executive secretary of the Air Pollution Control Association and a fellow of the Mellon Institute of Industrial Research.

C. R. Griffith, president, Southern Coal & Coke Co., was reelected president of the Southern Appalachian Coal Operators' Association. Also reelected were **Fred Loving Jr.,** Kentucky Ridge Coal Co.—first vice president, **P. B. C. Smith,** Pocahontas Fuel Co.,—second vice president, and the following directors: **Lindsay Young,** Garland Coal Co.; **R. H. Hughes,** Clinchfield Coal Co.; **Ray S. Walker,** Laddie Coal & Mining Co.; **Warren Haydon,** Wind Rock Coal & Coke Co.; **E. F. Wright,** Clinchfield Coal Co.; **W. T. Ray,** Meadow Creek Coal Co.; **D. R. Christian,** Beech Grove Mining Co.; and Messrs. Griffith, Loving and Smith.

J. O. Archer, personnel director of Blue Diamond Coal Co. for 31 yr, has been elected secretary of the Southern Appalachian Coal Operators' Association. He replaces Harry S. Homan who passed away recently. Mr. Archer has had experience in handling labor matters for his former company as well as for the Southern Appalachian, Hazard (Ky.), Harlan (Ky.) and Virginia coal associations. He is a long-time member of the Boy Scouts of America Council and a past president of the Optimist Club.

John W. Krous has been elected president of Imperial Coal Co., succeeding **George E. Owen,** who became chairman of the board. Mr. Krous was executive vice president for the past year. Other officers named by the firm are: **D. C. Farnsworth,** executive vice president; **H. J. Robert,** secretary; **A. F. Bietel,** assistant secretary; **J. N. Geyer,** treasurer; **and A. C. Ammon,** assistant treasurer.

Stephen Canonico, vice president of Clinchfield Coal Co.'s Compass mine, was named president of the Central West Virginia Coal Mining Institute, succeding **Blair Hill,** Blair Mine Supply, Inc.

"IN CASE OF EMERGENCY"

Mine emergencies happen without warning . . . and when they do happen, equipment that carries the "in case of emergency" label suddenly becomes vital to fire fighting and rescue efforts. Breathing protection devices are a major part of emergency mine equipment.

Below is a check list of this equipment offered by MSA. If you would like to make sure your emergency program is up-to-date, why not have our representative check your requirements and suggest a regular inspection and maintenance schedule.

M-S-A McCAA® Oxygen Breathing Apparatus—
gives complete breathing protection in any unbreathable atmosphere for a minimum of two hours. Used under the hardest physical conditions . . . in fighting and sealing fires, re-establishing ventilation, and rescue operations. U. S. Bureau of Mines approved.

M-S-A Chemox®—
allows complete breathing protection in any gaseous or oxygen deficient area for a minimum of 45 minutes. Generates its own oxygen supply from replaceable canister. Weighs only 13½ lbs. U. S. Bureau of Mines approved.

M-S-A All-Service Mask®—
assures safe, comfortable breathing protection against smoke and toxic gases including carbon monoxide—singly—or in combination where there is sufficient oxygen to sustain life. U. S. Bureau of Mines approved.

M-S-A Self-Rescuer®—
a miniature mask for use in deadly carbon monoxide following fire or explosion. Gives the miner precious minutes of emergency breathing protection. Unit is compact, lightweight; may be stored in quantity underground or carried individually. U. S. Bureau of Mines approved.

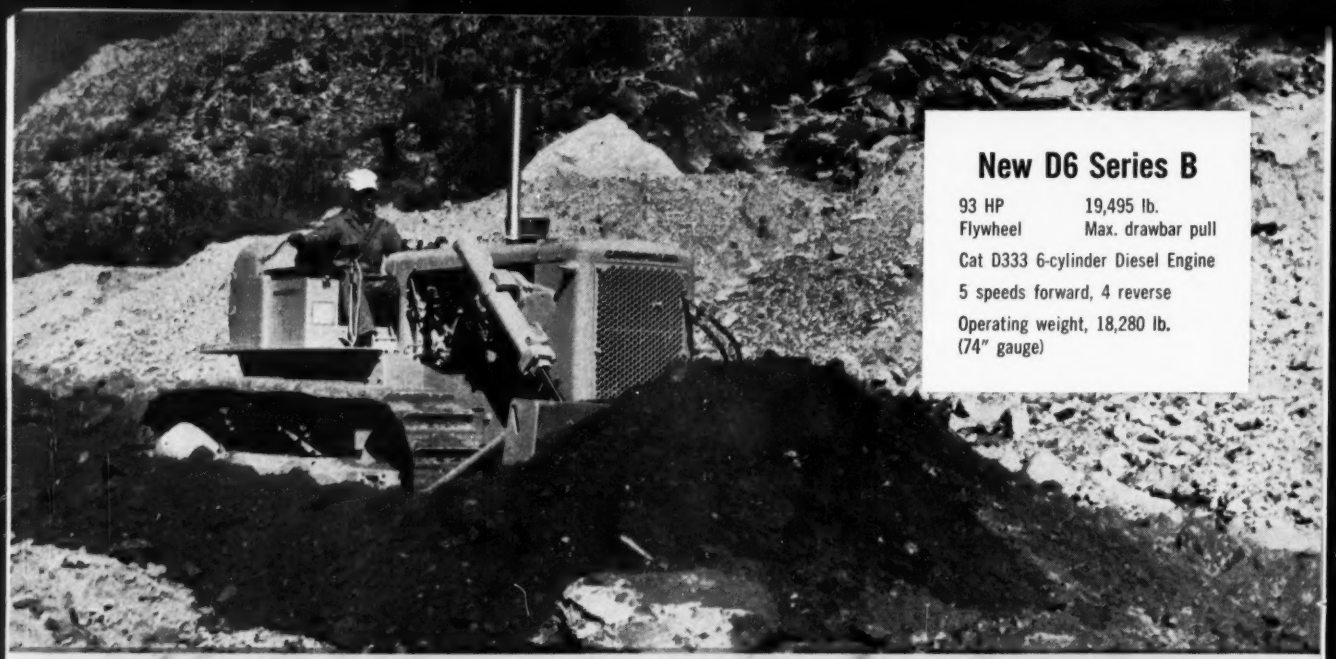
M-S-A Air and O_2 Mask—
designed for 30 minutes maximum breathing protection in any atmosphere—supplies air or oxygen in exact accordance with breathing requirements. Flow ceases during exhalation for added economy. Comfortable to wear and easy to use.

M-S-A Pneolator®—
provides automatic artificial respiration that assures maximum chances of recovery for victims of poisonous gases, electrical shock, heart attacks, or other causes of asphyxia. Housed in compact, lightweight glass fiber case.

MSA®
SAFETY EQUIPMENT HEADQUARTERS

MINE SAFETY APPLIANCES COMPANY
201 North Braddock Avenue, Pittsburgh 8, Pa.
At Your Service: 77 Branch Offices in the United States and Mexico

MINE SAFETY APPLIANCES CO. OF CANADA, LTD.
Toronto, Montreal, Calgary, Edmonton, Winnipeg, Vancouver, Sydney, N.S.



New D6 Series B

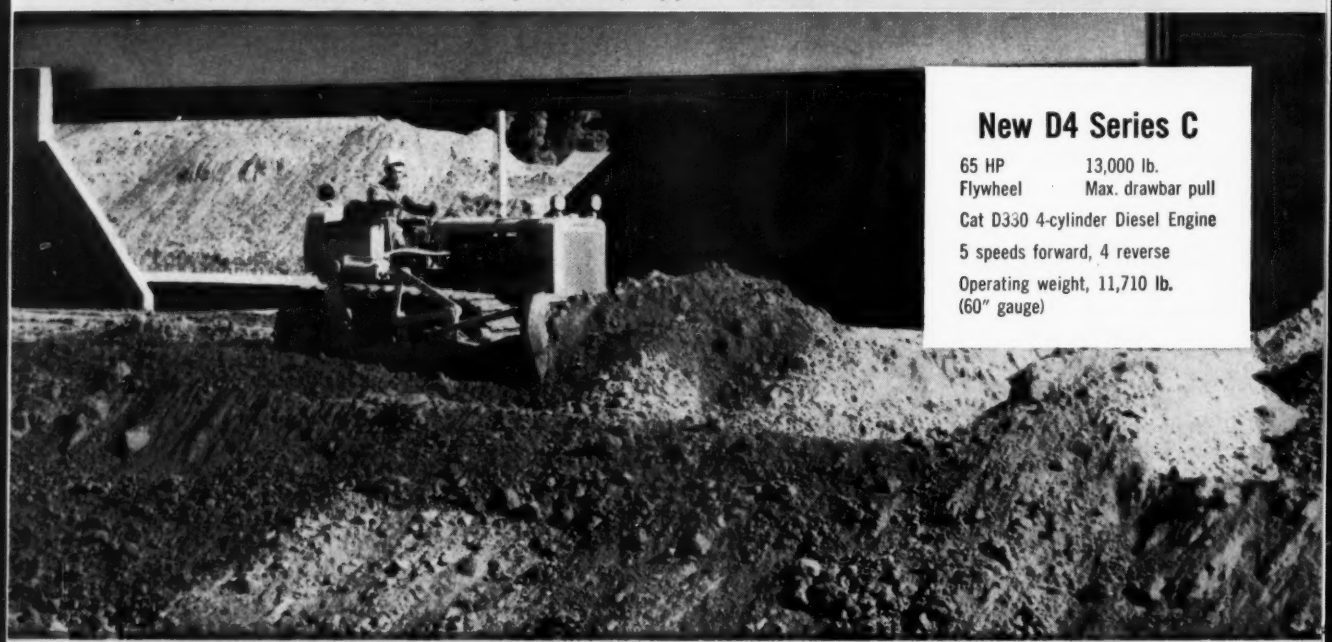
93 HP Flywheel — 19,495 lb. Max. drawbar pull

Cat D333 6-cylinder Diesel Engine

5 speeds forward, 4 reverse

Operating weight, 18,280 lb. (74″ gauge)

RUGGED MATCHED ATTACHMENTS for the D6 and D4 include Bulldozers, Tool Bar, Scraper, Rock Rakes, Winches, K/G Blade, Rippers and others.



New D4 Series C

65 HP Flywheel — 13,000 lb. Max. drawbar pull

Cat D330 4-cylinder Diesel Engine

5 speeds forward, 4 reverse

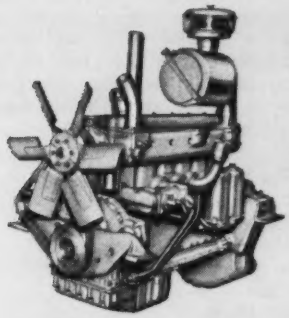
Operating weight, 11,710 lb. (60″ gauge)

IMPROVED STARTING ENGINE for both tractors has recoil starter for fast starts. Also 12-volt in-seat starting available. 24-volt direct electric starting optional.

CATERPILLAR ANNOUNCES the

completely redesigned for faster and greater production

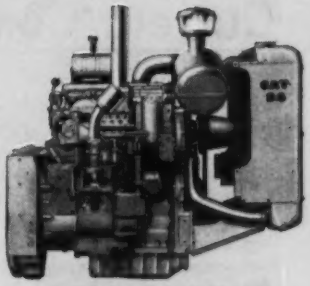
There's no time like now to upgrade your equipment spread. These two new tractors not only look different—they are different. Each, in its own class, answers your needs for higher production and greater operating economy. Some of their important new features are described on these pages. In addition to these improvements, each machine provides other famous Caterpillar features... the dry-type air cleaner,



D6 93 HP 6-cylinder Engine
Maximum drawbar pull, 19,495 lb. The D333 Engine provides power with dependability for a long life of economical operation.

New Caterpillar Diesel Engines deliver 25% more lugging ability

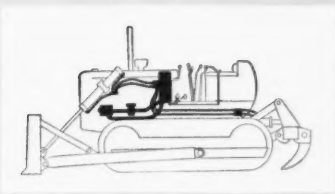
For the D6 and D4, two completely new Cat Diesel Engines. 25% more lugging ability. New compactness with new ruggedness. Famous Cat fuel injection pumps in new, easily serviceable housing. New direct acting governor that makes quick fuel adjustments, picks up loads fast. New, improved gasoline starting engine.



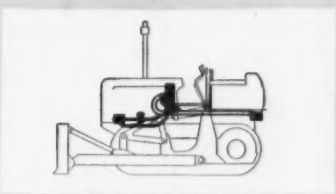
D4 65 HP 4-cylinder Engine
Maximum drawbar pull, 13,000 lb. New design of the D330 results in smooth, vibration-free performance in all speed ranges.

New integral hydraulic systems put more power where you need it

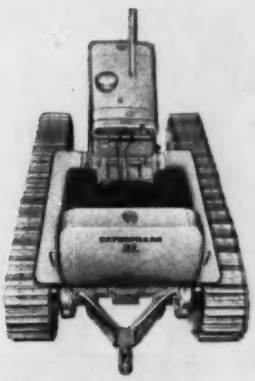
More work power at the tools—that's one of the big advantages of these new Cat hydraulic systems. Under-the-hood mounting of tank, pump and valves permits convenient routing of hydraulic lines to bulldozer or implement cylinders, frees front and rear for mounted equipment. Center-pivoted cylinder mounting on D6 gives increased blade lift/drop range for greater production. Hydraulic control system provides hand control for bulldozer and/or ripper, foot control for tilt cylinder on D6.



D6 Integral Hydraulic System
No. 165 Hydraulic Control for bulldozer
54 GPM Pump—1500 PSI
No. 143 Hydraulic Control for No. 6 Tool Bar
29 GPM Pump—1700 PSI



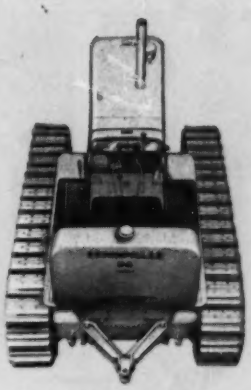
D4 Integral Hydraulic System
No. 143 Hydraulic Control with:
29 GPM Pump—1700 PSI for bulldozers
17 GPM Pump—1700 PSI for tool bars



D6 operator's compartment

New operator convenience and comfort in co-ordinated compartments

The cockpits are all new. Controls are co-ordinated to make one motion flow into the next, reducing hand movements and speeding every operation. Forward-reverse lever (new on the D4) is next to the operator's right hand to speed 'dozer cycle times. Short-travel transmission speed selector shifts gears easily, quickly. Boosters for steering clutches save muscles . . . increase efficiency.



D4 operator's compartment

New D4 Series C and D6 Series B Tractors

hydraulic track adjusters, lifetime lubricated track rollers, the oil clutch, the forward-reverse lever. Your Caterpillar Dealer will be happy to give you the complete facts about both the new D6 and the new D4 and demonstrate them on any of your jobs. The tougher, the better.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U. S. A.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

BORN OF RESEARCH
PROVED IN THE FIELD

Current Coal Patterns

By: **Oliver S. North**

Tamping plug, J. J. Douglass and C. M. Pomeroy (assigned to E. I. du Pont de Nemours & Co., Wilmington, Del.), Dec. 15, 1959. A tamping plug for temporarily confining the blast force from explosives detonated in a small diameter borehole consists of polyethylene or polyvinyl chloride cylinder provided with a plurality of flexible radial fins. When the plug is pushed into the hole, the fins are deformed into the shape of rearwardly directed cups. No. 2,916,995.

Apparatus for separating mixtures into a fraction containing particles of low specific gravity and another fraction containing particles of high specific gravity, J. N. J. Leeman (assigned to Stamicarbon N.V. Heerlen, Netherlands), Dec. 15, 1959. Design for a sink-float coal separating apparatus utilizing a ring structure provided with blades encircling the separating tank and passing through an arcuate housing in open communication with the bottom of the tank. The sink particles are permitted a longer period of time to sink past the edges of the housing prior to the blades coming into close proximity with the side walls of the housing, thus reducing blade damage caused by jammed sink particles and decreasing the amount of power necessary for driving the ring structure. No. 2,917,172.

Screening apparatus, F. J. Fontein (assigned to Stamicarbon N.V., Heerlen, Netherlands), Dec. 15, 1959. Design for an improved screening apparatus of the type having a cylindrically bent screening deck mounted between two side plates, a conduit for feeding a slurry of coal and water tangentially to the concave side of the screening deck, and devices for discharging the separated fractions. Capacity is increased by arranging the coarse fraction discharge receiving means so that the length of the screening deck can be extended to the maximum arcuate distance. Creation of partial vacuum in the space enclosed by the screening deck is substantially prevented, so as to permit efficient separation therethrough. No. 2,917,174.

Mining machine, A. L. Lee (assigned to Consolidation Coal Co.), Dec. 15, 1959. Design for a readily mobile mining machine having a working element capable of performing the combined functions of drilling and timber setting, especially for drilling holes at various locations in the roof and walls and also for raising and holding the roof supports up against the roof during their installation. The machine is rugged, flexible in operation, and has a wide range of adjustment. No. 2,917,282.

Mining and excavating machine of the rotary type, J. P. Ruth, Dec. 29, 1959. Improved mining machine for generating and advancing a cylindrical bore through natural earth strata with concurrent removal of excavated material. The excavating head revolves around a central axis. No. 2,919,121.

Coming in *Coal Age* . . .

An exclusive story defining how, in the last 2 yr, new management at Glen Alden has turned a 6-yr loss record into profit and put the Nation's leading anthracite firm on the road to solid recovery and growth.

For fast, easy installations...
BOLT WITH "Top-Tite"!
Here's what bolting people have been looking for!
A STEEL SHELL that leads the way in...
TIGHTENING...HOLDING POWER...RELIABILITY
You can cut your bolting time and bolting costs as well by using "Top-Tite" shells. "Top-Tite" gives you maximum expansion in minimum time!
Have you had trouble with plug pull-out . . . leaf breakage . . . misalignment? Instead of merely lessening these problems, "Top-Tite" eliminates them. Experienced roof bolting engineers are ready to help you with your bolting problems. Call or write National Mine Service today!
Available in Bell or Standard types for any ⅝" or ¾" roof or rock bolts.
THOMPSON Top-Tite EXPANSION SHELLS
MANUFACTURED BY
THOMPSON PRODUCTS VALVE DIVISION
Thompson Ramo Wooldridge Inc.
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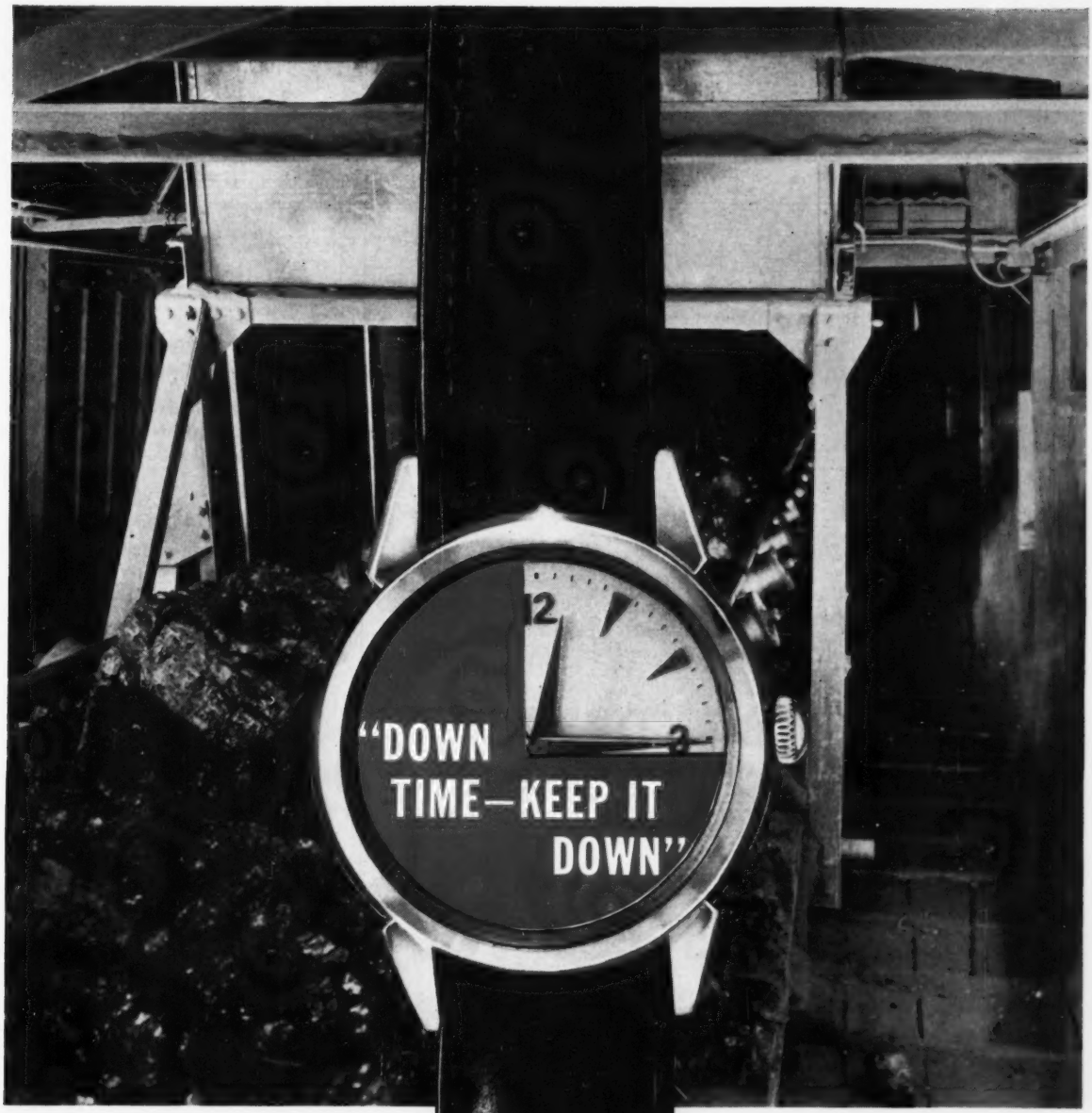
STOCKED AND DISTRIBUTED BY
National Mine Service Company
KOPPERS BUILDING PITTSBURGH 19, PA.
JENKINS, KY.
LOGAN, W. VA.
PORTY FORT, PA.
BECKLEY, W. VA.
MORGANTOWN, W. VA.
INDIANA, PA.
MADISONVILLE, KY.



Poor lubricants can cause down time. So can *good* lubricants, unsuited to the equipment or the operating conditions. Does this sound complicated? You can simplify it easily. Do as hundreds of mine operators do—call in the Amoco lubrication engineer. He knows all kinds of deep and strip mining equipment by make and model . . . knows the various operating conditions . . . knows just which of Amoco's complete line of quality tested lubricants to use. Let the Amoco man survey your needs without charge . . . show the way to better performance at lower costs. Contact your nearest Amoco office, or American Oil Company, 555 Fifth Avenue, New York 17, N. Y.

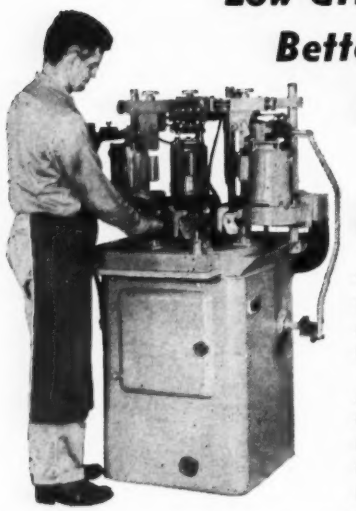
AMOCO®

AMOCO LUBRICANTS

For Mine Machinery

When you want performance, you want Amoco.

Low Grinding Costs
Better Performance
Fast Production
Uniform Results
Maximum Bit Life



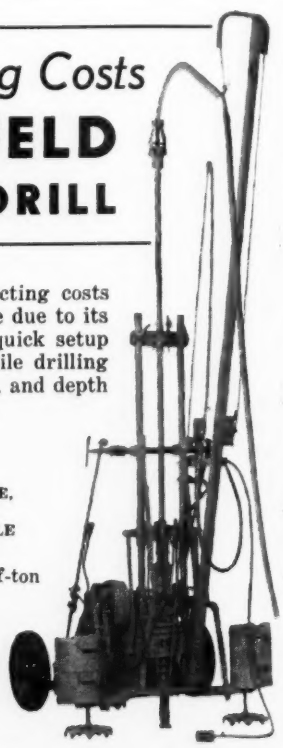
These are a few of the many advantages you get when you grind your bits automatically on the FAIRVIEW BIT GRINDER.

All of these advantages boil down to savings of both labor and wheels, productivity of 250 to 350 per hour, correct angles—smooth finish, more regrinds, more grinds per bit, more tons per grind and elimination of hazardous operation. It's to your advantage to use the FAIRVIEW BIT GRINDER both in the satisfactory grinding results obtained and in the protection of your investment in expensive equipment.

WRITE TODAY for fully descriptive bulletin!

FAIRVIEW BIT COMPANY
FAIRVIEW, WEST VIRGINIA

Cut Your Strip Mining Costs with a HOSSFELD PROSPECTING DRILL



ACTUAL field runs prove that prospecting costs can be cut with this fast working machine due to its many economical working features and quick setup time. Samples are taken continuously while drilling to accurately determine type of formation, and depth of vein or ore body, up to 110 feet deep.

- POWERFUL DIRECT DRIVE
- ONE MAN OPERATION
- ECONOMICAL 5 H. P. GASOLINE ENGINE, AIR COOLED
- LIGHT WEIGHT — COMPACT — PORTABLE

Designed to fold into a half-ton pickup, trailed in the field on its own chassis, or dismantled for easy packing over rugged terrain.

WRITE TODAY . . . for illustrated bulletin "Take the guesswork out of Mining"

HOSSFELD MFG. CO.
440 W. 3rd Street, Winona, Minnesota

Preparation Facilities

Green Coal Co., Panther mine, Owensboro, Ky.—Contract Closed with Fuel Process Co., Inc., for reinstallation of a 120-in Belknap calcium chloride washer, three CMI centrifugal dryers, two 24-in Heyl & Patterson cyclones and the pumps, piping, vibration screens and other equipment to wash and dry about 150 tph of 1¼x14 coal.

South East Coal Co., Paintsville, Ky.—Contract closed with The Deister Concentrator Co., Inc., for eight SuperDuty Diagonal Deck No. 7 washing tables, Model HCRD, and one Concenco Model 108 revolving-feed distributor. Equipment will be used to clean ¼x0 bituminous.

Red Bud Mining Co., Jaeger, W. Va.—Contract closed with Jeffrey Mfg. Co. for No. 100 unit washery; capacity, 75 tph.

Cannelton Coal & Coke Co., Cannelton, W. Va.—Contract closed with Kanawha Mfg. Co. for one additional CMI dryer to augment existing battery of three units; capacity, 60 tph of ¼x0 coal.

Utility Coal Co., Marion, Ill.—Purchase authority granted to the Daniels Co. for complete drier installation to handle fine coal portion of product from firm's DMS preparation plant, including drier, conveyors and all other auxiliary equipment.

Meetings

American Institute of Mining, Metallurgical & Petroleum Engineers, Inc., annual meeting, Feb. 14-18, 1960 — New York, N. Y.

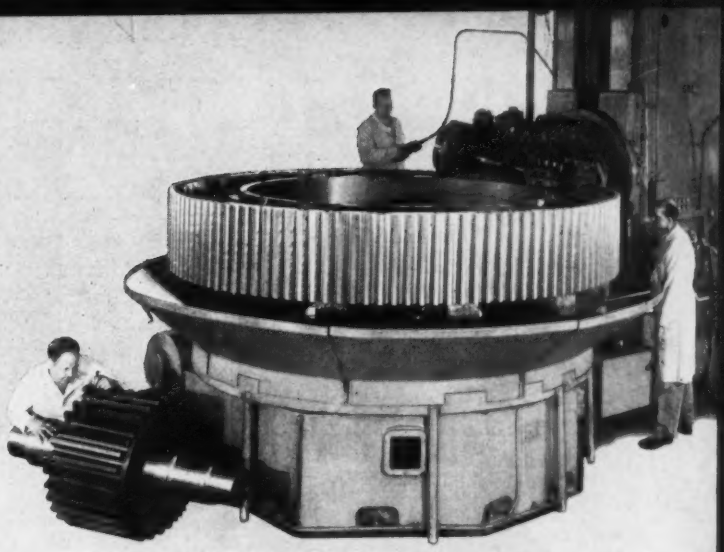
The Institution of Mining & Metallurgy, International Mineral Processing Congress, April 6-9—London, Eng.

American Mining Congress, 1960 Coal Convention, May 9-11—Pittsburgh, Pa.

Charbonnages de France, International Conference on Strata Control, May 16-20, 1960. Presentation of results obtained from laboratory experiments and underground measurements and observations—Paris, France.

Appalachian Underground Corrosion Short Course, June 1-3, 1960. Fifty-seven classes, 15 new papers and 25 new speakers—West Virginia University, Morgantown, W. Va.

GEARS FOR EVERY PURPOSE



Machining the large spur gear for driving the digging wheel of the huge Kolbe Excavator.

Throughout the world—wherever gears are used—ILLINOIS GEARS have a matchless reputation for dependability and superiority that is constantly being proven by their performance in such equipment as this mammoth Kolbe Wheel Excavator designed by the United Electric Coal Companies.

One can well imagine the enormity of engineering work required to design and build this giant earth mover and the responsibility of the components which include numerous ILLINOIS GEARS, in assuring its successful operation.

If you want gears that are made right, *with quality as the first consideration,* specify and buy ILLINOIS GEARS. Ask for full information today.

It takes 3500 cubic yards of earth an hour to satisfy the powerful appetite of this Kolbe Wheel Excavator which is clearing the overburden from a coal strip near Canton, Illinois.

Look for this mark ILG *. . . the symbol on finer gears*

ILLINOIS GEARS Reg. U.S. Pat. Off.

Gears for Every Purpose ... one gear or 10,000 or more

ILLINOIS GEAR & MACHINE COMPANY

2108 NORTH NATCHEZ AVENUE • CHICAGO 35, ILLINOIS

4-wheel tractor-scraper with Hi-Torque brakes

Heavy rear dump with Hi-Torque brakes

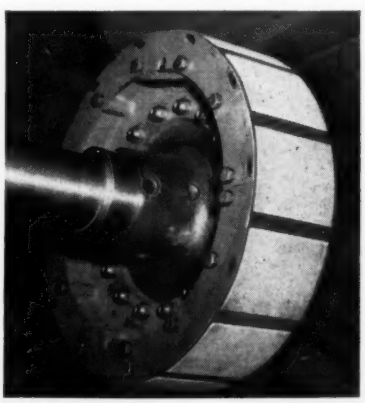
For your heavyweight vehicles get double braking power with Hi-Torque brakes

Operators of heavy off-road vehicles are finding that Hi-Torque brakes boost their profits—and that's a feature to consider when choosing *your* heavy equipment.

Hi-Torque brakes give the "heavyweights" adequate safety and controllability—stop vehicles in approximately half the distance required for conventional two-shoe brakes. With this reserve braking power, cycle time can be reduced as equipment is operated in higher gear. Operators can tackle grades usually considered unsafe, since Hi-Torque brakes don't fade, will stop a fully loaded vehicle downhill!

Specify Hi-Torque brakes on your equipment—ask the vehicle manufacturer for details. Or write *B. F. Goodrich Aviation Products, a division of The B. F. Goodrich Company, Dept. CA-2, Troy, Ohio.*

2-wheel tractor with Hi-Torque brakes



Full circle contact with drum is provided by Hi-Torque brakes giving maximum effective braking surface in the same size unit. Hi-Torque stops vehicles twice as fast as conventional brakes.

B.F.Goodrich

Hi-Torque brakes

Femco systems and products for more efficient mining

Femco, Inc. engineers and develops systems for communication, monitoring and remote control which meet the rigorous requirements of the mining industry. Standard systems, together with certain other Femco products, are summarized below. We are prepared not only to supply the systems listed but also to develop special systems for other mining applications.

Communication Systems

Trolleyphone 3000—Newest model of the first practical mine communication system for use between moving and stationary locations. Microphone and loudspeaker conversation. Carrier system utilizes existing lines.

Loudspeaking Mine Telephone—Communication between fixed points underground. Two-way loudspeaker paging saves time—brings you into immediate contact. No ringing station after station. System is battery powered, 100% transistorized.

Wired Audio Systems—For cleaning and preparation plants, and for surface supervisory personnel. Paging over wide areas. Special four-wire communication cable. Handsets or integral microphones. Desk and paging stations available.

Cagephones—For cage installations in deep mines. Separate or integral microphone and speaker units. Low voltage battery powered. FM carrier current utilizes hoisting cable or other existing wires.

(East of the Mississippi, all Femco mine communication systems are distributed by National Mine Service Company.)

Monitoring and Remote Control Systems

Femco 709—Monitors fans and circuit breakers; automatically cuts off power into mine in the event of fan failure; provides selective control of all circuit breakers from a central point. Requires a single two-wire parallel circuit.

Pump Monitoring and Control—Provides centralized indication and control of pump operation. Requires a two-wire parallel circuit, which may be integrated with circuit for Femco 709 system.

Shot Firers

Femco 10-Shot—Capacitor operated, assuring adequate energy output. Bureau of Mines Approval #1603.

New 20-Shot—Manufactured by Femco for major powder companies. No "weak" shots—special safety circuit prevents firing unless capacitor is fully charged. If operation is stopped after charging starts, charge is drained from the capacitor—cannot enter wires. Bureau of Mines Approval #16D-9.

Mine Lights

Femco Fluorescent System—To illuminate working areas between the face and the loading head. Dust-proof, completely portable units give excellent illumination at low cost. Approved by Bureau of Mines for gassy atmospheres.

We will be pleased to send you full information on any of these systems and products, or to discuss any special problems of communication or remote control.

A-200

Femco, Inc., Irwin, Pennsylvania

Femco

COMMUNICATIONS: Carrier and wired audio systems for all mining and industrial applications. **MONITORING:** Fans, circuit breakers, valves, pumps, compressors, etc. **TELEMETERING:** Flows, pressures and other functions. **REMOTE CONTROL:** Pumps, valves, circuit breakers, soaking pit covers, furnace doors, cranes, or other moving equipment.

Equipment Approvals

Ensign Electric & Mfg. Co.—Type J single-breaker distribution box; 220-/440 V, AC. Approvals Nos. 2F-1515 and 2F-1515A, Dec. 1.

Joy Mfg. Co.—Type WK-82-M-130R air compressor; two motors, each 50 hp, 440 V, AC. Approval No. 2F1516A, Dec. 3.

Lee-Norse Co.—Model CM38-1K/M continuous miner; three motors, each 50 hp, 250-/550 V, DC. Approvals Nos. 2F-1517 and 2F-1517A, Dec. 4.

Joy Mfg. Co.—Model 15BU2-1BE loading machine; seven motors, six 15 hp and one 4 hp, 250 V, DC. Approval No. 2F-1518, Dec. 7.

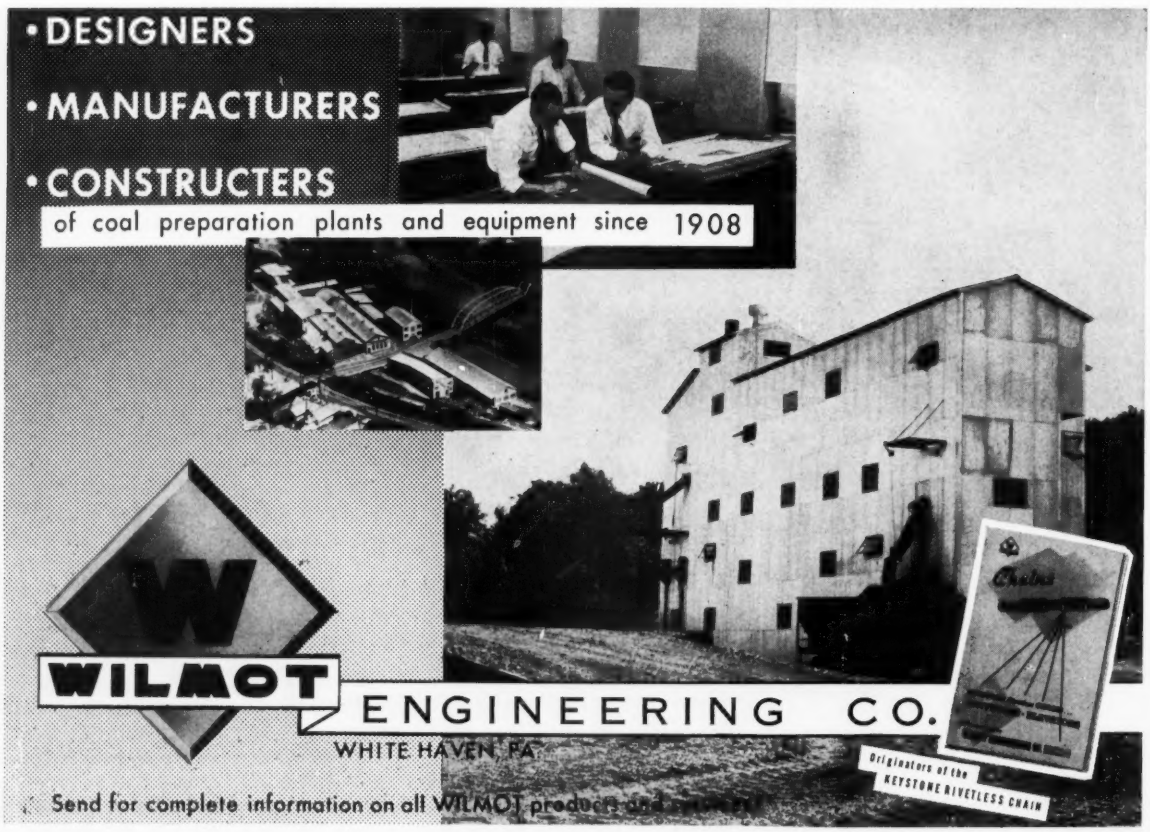
The Jeffrey Mfg. Co.—Type 6F-28 aerodyne fan; one motor, 25 hp, 250 V, DC. Approval No. 2F-1519, Dec. 11.

Goodman Mfg. Co.—Type 405 continuous borer; three motors, two 100 hp and one 50 hp, 440 V, AC. Approval No. 2F-1520A, Dec. 15.

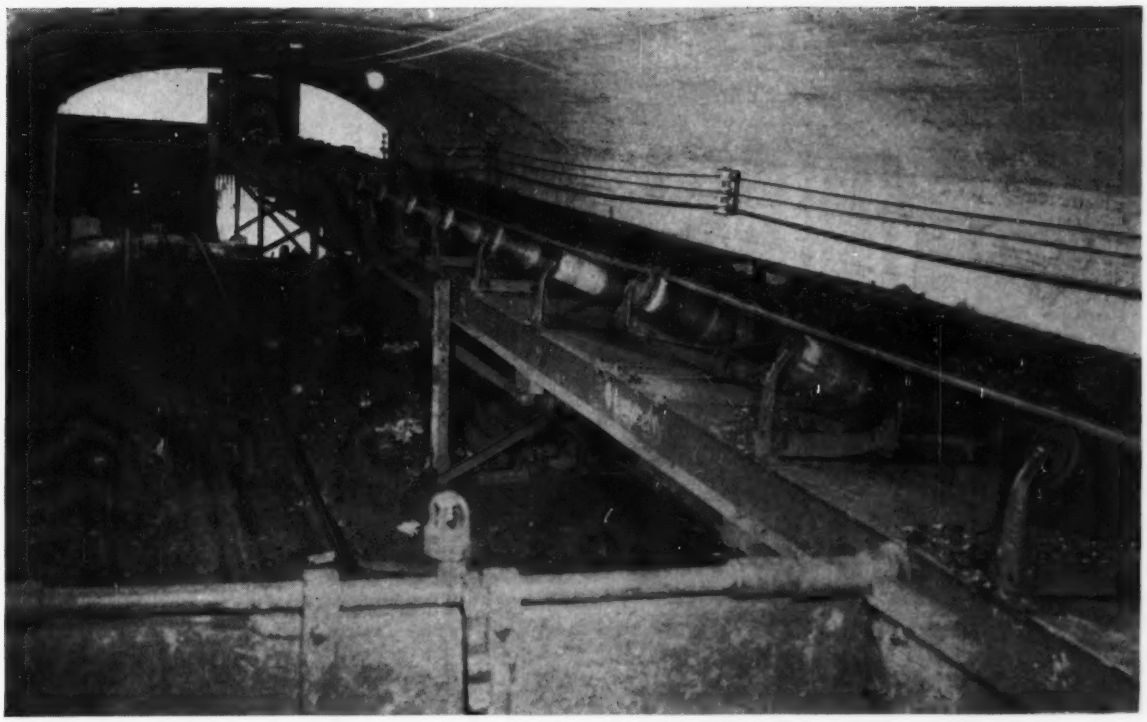
Joy Mfg. Co.—Type CD43 coal drilling machine; one motor, 26 hp, 250 V, DC. Approval No. 2F-1521, Dec. 16.

Goodman Mfg. Co.—Type 427 continuous borer; two motors, one 250 hp and one 50 hp, 550 V, AC. Approval No. 2F-1522A, Dec. 21.

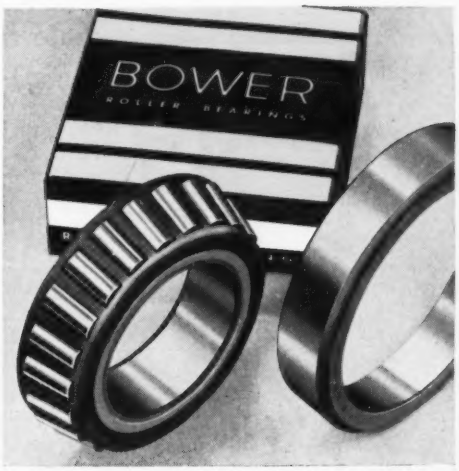
MAIN STREAM and hot-and-cold reheat lines, serving a 170,000-kw turbine generator installed at the new Stratton, Ohio, plant of Ohio Edison Co., are ready to go. The turbine is powered by a coal-fired boiler providing steam at pressure of 2,400 psi at 1,050 F., and reheat at 1,000 F. Three more units will be installed on a one-a-year basis in the summers of 1960, 1961 and 1962. The heavy wall piping, erected by Dravo Corp., of Pittsburgh, is up to 18 in in diameter and 3 in thick, and was fabricated to exacting tolerances at Dravo's shops.



Better products, *faster*, from your Bearing Specialist:



Bower Roller Bearings give belts a boulevard ride... better for every kind of replacement!



Favorites of equipment builders and men who must keep big loads rolling!

You can be sure of keeping your equipment rolling and earning even under the roughest conditions. Bower builds in longer life, easier running refinements that pay off in high tonnage service. Bower tapered roller bearings are Spher-O-Honed . . . roller heads are spherically contour-ground. They need no run-in. Extra-high flanges cut unit pressure—improve alignment. Oil grooves are bigger for positive roller lubrication. Honing processes super-finish inner and outer races for smoother rolling action. All these combine to add longer life and lower maintenance cost.

Bower builds both tapered and straight roller bearings. Your Bearing Specialist stocks both types . . . and gives fast delivery on each. Call him anytime.

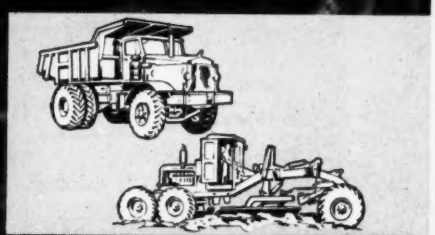
BOWER ROLLER BEARINGS

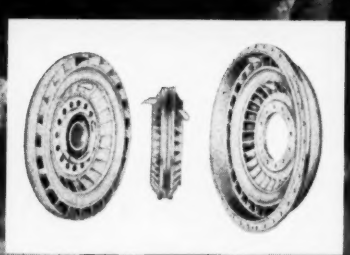
FEDERAL-MOGUL SERVICE

DIVISION OF FEDERAL-MOGUL-BOWER BEARINGS, INC. • DETROIT 13, MICHIGAN

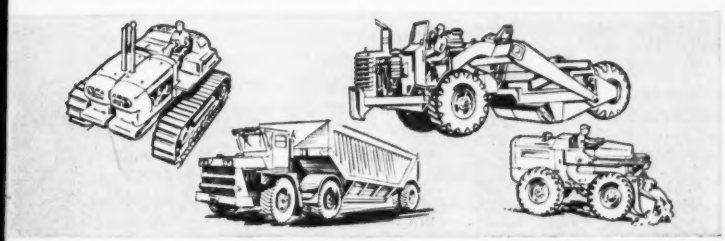
BEARING BOWER ROLLER BEARINGS SERVICE

What's it costing





you to keep the clutch pedal?



THE ACTUAL FIGURES are on your own cost sheets: Engine-disconnect clutch replacements at $800 or more each year (plus expensive downtime)—too-frequent overhauls of overtaxed engines at $1,200 to $1,500 each—constant repair bills for shock-load-damaged axles and drive lines —$1,500 to $2,000 in equipment damage every time you train a rookie driver.

What Can You Do About These Costs?

Now mark this: When your equipment has Allison TORQMATIC DRIVES, you eliminate these costs—or cut them to amazing new lows. Engine-disconnect clutch repairs are ended, so is shock-load damage. New drivers practically never make a costly shifting mistake. You save one engine overhaul out of three.

So you're money ahead no matter how good your present clutch-pedal equipment is—or how skillful the men who operate it. For TORQMATIC takes over the clutching job—adjusts power output to every change in load demand—protects your whole power train every working minute.

Can You Afford to Pay the Penalty?

Can you afford, then, to pay the penalty of owning old-fashioned clutch-pedal equipment—especially when it means competing against other owners who looked past first cost and are now enjoying TORQMATIC savings?

Remember, no other heavy-duty hydraulic transmission has been so thoroughly battle-tested over the years. And you can get it in over 100 makes of equipment of most every type. See your equipment dealer—or write Allison for the full story.

ALLISON DIVISION OF GENERAL MOTORS
Indianapolis 6, Indiana
In Canada: General Motors Diesel Ltd., London, Ontario

Allison TORQMATIC

TORQMATIC® DRIVES

THE MODERN DRIVE FOR MODERN EQUIPMENT

Built stronger to last longer—Allison casts its converter for extra strength, greater precision —and the converter is *integrated* with the transmission for a neat, easily serviced installation.

MASTER MECHANICS CORNER:

Karl Wernle, Master Mechanic in charge of 250 machines for McDougal-Hartmann Co., Peoria, Illinois, working on Illinois Interstate Highway Rt. 74 at Peoria, Ill.

"Most bolts and nuts don't seem to hold our equipment together when the going's rough. We've found Cat bolts and nuts do."

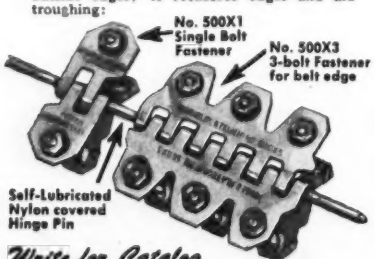
Caterpillar Tractor Co., General Offices, Peoria, Ill., U. S. A.

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

for Conveyor Belts that must be extended or shortened

New HINGED PLATEGRIP

Recommended for mines, quarries, construction work, storage yards — wherever belts length must be frequently changed. Hinged Plategrip Fasteners make a strong, flexible joint in heavy duty conveyor belts, trough naturally, ride smoothly over pulleys, yet can be separated by simply pulling the hinge pin. *Improved* design takes the new smaller diameter self-lubricating nylon sheathed cable hinge pins. No. 500X1 single bolt fasteners and No. 500X3 3 bolt fasteners (used at outside edges) to reinforce edges and aid troughing:



Write for Catalog

ARMSTRONG-BRAY & COMPANY

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New Books

The Business Picture

New Forces in American Business, by Dexter M. Keezer and Associates studies the outlook of the United States economy for the next 10 yr. Mr. Keezer concludes that American business will continue to grow and prosper in the 60's. Among the ingedients contributing to the optimistic outlook are: (1) greater business investment; (2) new research; (3) continuing increase of middle income families; and (4) more marketing. For executives and other interested in the economic picture in the next 10 yr, this work offers an easily understood and down-to-earth forecast. *278 pp. 5½x8-in; cloth. $4.75, McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y.*

Lamps and Lighting

Primer of Lamps and Lighting, by Willard Allphin gives basic information on lighting to enable the reader to deal with lamps and lighting layouts. In simple style the author makes lighting understandable to the practical man, electrical contractor, building maintenance man and electrical foreman. An important feature of the book is a slide rule inserted in a back pocket of the cover, which makes the mathematics of the Lumen formula easy to apply. *224 pp. $10.00, Chilton Co., Book Div., 56th & Chestnut Sts., Philadelphia 39, Pa.*

Public Speaking

Executive Public Speaking Techniques, by Harry Simmons is designed to help executives improve their speaking methods. Included in the book are ideas, hints and notes on speech peculiarities and the right ways to correct them. *246 pp. $5.00, Chilton Co., Book Div., 56th & Chestnut Sts., Philadelphia 39, Pa.*

Better Employee Relations

Personnel Management in Small Companies, by Frances Torbert is designed to help the line executive in the small company develop a positive personnel program. Although the booklet is aimed chiefly at companies with fewer than 200 employees, it offers much useful material for personnel managers in larger companies. Executives will find especially helpful the sections on organization and delegation in the small firm, staffing the company, induction and training, and motivation, morale and supervision. *102 pp. 5¼x7½-in; paper. 50¢ single copy, quantity discounts; Institute of Industrial Relations, University of California, Los Angeles 24, Calif.*

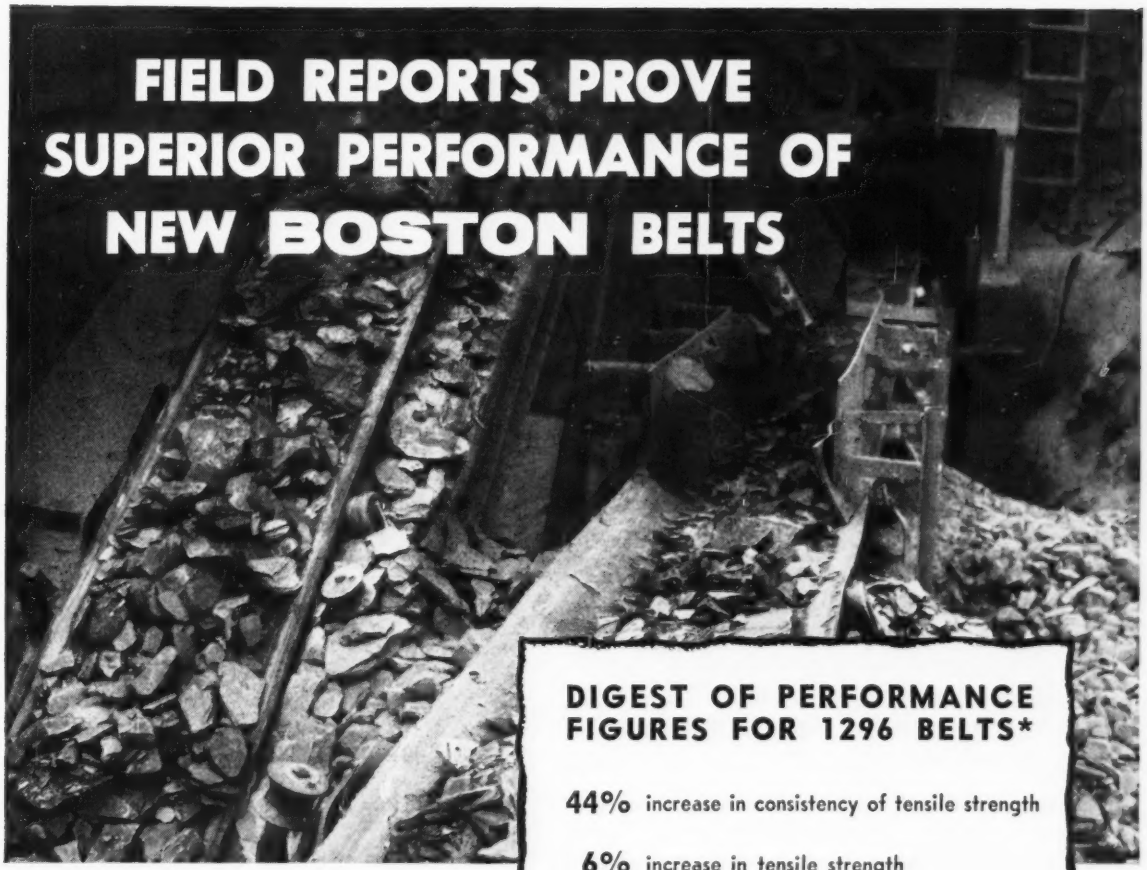
Plant Operation

Standard Plant Operator's Questions and Answers, by Steve Elonka and J. F. Robinson provides up-to-date answers in problems met in 17 modern types of industrial, utility and building power equipment. Detailed information is included on such advanced subjects as electronic instruments and control devices, gas turbines and nuclear power plants. The book also provides explanations, drawings and diagrams, and calculations relating to pumps, instruments, electricity, vacuum tubes, building heating, lubrication and others. *Two volumes, 518 pp. 5⅜x8-in; cloth. Single volume $8.00; two-volume set, $14.95, McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y.*

Hydraulic Mining

Mining and Transporting Coal Underground by Hydraulic Methods: A Literature Survey, by W. T. Boyd presents information obtained by reviewing foreign technical publications in preparation for researeh the U. S. Bureau of Mines is conducting to find out whether high-pressure jets of water can be used to mine coal economically in the United States. *Information Circular 7887. 30¢, Superintendent of Documents, United States Government Printing Office, Washington, D. C.*

FIELD REPORTS PROVE SUPERIOR PERFORMANCE OF NEW BOSTON BELTS



DIGEST OF PERFORMANCE FIGURES FOR 1296 BELTS*

44% increase in consistency of tensile strength

6% increase in tensile strength

130% improvement in consistency of elongation

* Compared to belts previously manufactured

HERE'S WHAT DOES IT!

The startling figures above are a direct result of two major belt manufacturing advancements — both developed by, and exclusive with, Boston Woven Hose & Rubber Co.

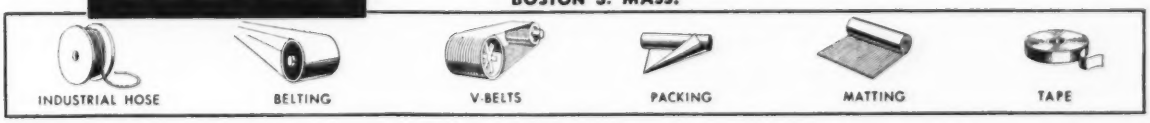
ADVANCEMENT #1 **BALANCED BELT CONSTRUCTION** for the first time equalizes ply stress so that each ply pulls its full share of the load. **BBC** eliminates lazy plies. A BOSTON exclusive because only BOSTON can combine Electronic Tension Controls with Rotocure, the continuous method of vulcanization, which assures uniformity throughout the belt.

ADVANCEMENT #2 **DULON** markedly improves the aging characteristics of BOSTON belts. An exclusive BOSTON research development, the tough specially treated cover compound stays resilient longer . . . makes the belt much more resistant to abrasion, gouging, tearing and oxidation.

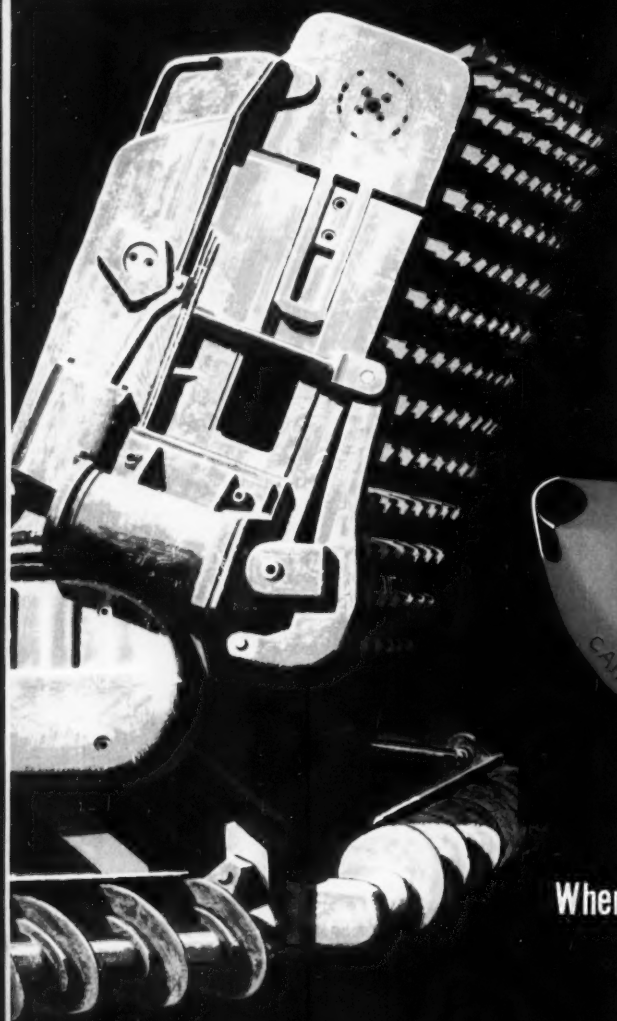
BALANCED BELT CONSTRUCTION plus **DULON** add up to longer belt life . . . less trouble in service . . . greater economy.

BOSTON

BOSTON WOVEN HOSE & RUBBER COMPANY
DIV. OF AMERICAN BILTRITE RUBBER CO., INC.
BOSTON 3, MASS.



Metallurgical Memo from General Electric



Why gamble with 200 to 1 odds?

When you can protect your "miner" investment with Carboloy® machine bits

Bit illustrated: CCS-2

ADN STYLE

Auger Bit—Tipped with the finest carbide made—for longer tool life . . . "V" prong for faster penetration. (Square and Hex shank.)

CC-8 STYLE

Machine Bit—Negative Rake, stronger cutting edge . . . tip, in compression, with greater support utilizes maximum carbide strength . . . fewer bit changes.

Proved uniform quality, mine engineered, more grinds per bit, more tonnage per dollar

Can you afford to gamble on anything but first quality bits? Consider the big investment in your drills, continuous miners, etc. Stack the cost of any one of these pieces of equipment against the cost of teeth that do the cutting. The odds are big in favor of the finest quality bits. That is the reason so many operators are making replacements with Carboloy mining tools . . . the silver-colored bits. Your Carboloy Mining Tool Distributor has them for immediate delivery. If not, write or phone Metallurgical Products Department of General Electric Company, 11120 E. 8 Mile Ave., Detroit 32, Michigan.

CARBOLOY®
CEMENTED CARBIDES

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES • MAN-MADE DIAMONDS
MAGNETIC MATERIALS • THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

Complete service through factory and distributor assistance

AUTHORIZED CARBOLOY MINING TOOL DISTRIBUTORS

ALABAMA
Birmingham 2—Shook & Fletcher Supply Company

COLORADO
Denver—The Mine & Smelter Supply Company

ILLINOIS
Mt. Vernon—Pickard Industries, Inc., Central Mine Supply Division

INDIANA
Terre Haute—The Mine Supply Company, Inc.

KENTUCKY
Harlan—Kentucky Mine Supply Co., Inc.
Lothair—Speck Cornett Distributor, Inc.
Madisonville—Pickard Industries, Inc., Central Mine Supply Div.
Paintsville—Farmers Supply Co.
Pikeville—Big Sandy Electric & Supply Co.

OHIO
Cambridge—Cambridge Machine & Supply Co., Inc.

OREGON
Portland—J. E. Haseltine & Company

PENNSYLVANIA
Charleroi—Mining Tool Service
Lee Supply Co.
Washington—Fairmont Supply Company

TENNESSEE
Knoxville—Crowell Engineering Company

TEXAS
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UTAH
Salt Lake City—The Mine & Smelter Supply Co.

VIRGINIA
Andover—Central Supply Co., of Va., Inc.
McClure—Erwin Supply Company

WEST VIRGINIA
Bluefield—Bluefield Supply Co.
Bluefield—Fairmont Supply Company
Bluefield—Rish Equipment Company
Charleston—Rish Equipment Company
Clarksburg—Rish Equipment Company
Fairmont—Fairmont Supply Company
Montgomery—Marathon Coal Bit Company, Inc.
Shinnston—Erwin Supply Company

Coal Abroad

Who Said "It Can't Happen Here"?

Economists blink in disbelief as Russia and Poland wage a battle for coal export markets.

WITHIN the Soviet circle of communism, a curious, almost sacrilegious thing is happening. Two state-planned economies, those of Russia and Poland, are facing each other in a fiercely competitive struggle for the export markets in central European and Scandinavian countries.

The friendly "plenty of room for all" tactics of Russia apparently are changing as Poland appears to be feeling increasing pressure of Soviet coal deliveries to countries which were until recently unmistakably Poland's province. Soviet foreign trade missions in various European nations have been offering Russian coal at prices far below the Polish sales level, and the results are reflected in the figures.

For example, Polish exports to Finland, which amounted to 1,700,000 metric tons in 1957, dwindled to 1,100,000 metric tons in 1959 while Soviet coal deliveries to Finland were increasing from 600,000 metric tons in 1957 to 1,500,000 for 1959. The same thing has been happening in Austria, which has severely lowered Polish coal purchases, and in the Balkan area (South-East Europe).

It is believed by sources close to the situation that the massive Soviet coal sales campaign is only a warning of things to come. Feeling runs that the USSR will drive hard to place more of its surplus coal within western and southern Europe; United States coal could become a target of dump prices.

Russia

Peat can now be used economically in thermal powerplants, report Russian engineers, who say they have developed a process for the near-immediate use of freshly-cut peat in boilertanks.

The engineers are said to have designed and built the first system where freshly-cut peat is first placed in small bricks in a dry-heat furnace where a constant saturation temperature is maintained. The peat is then passed into another chamber where super-heated steam is brought in contact with the peat. Mechanical turning mechanisms rotate the peat constantly, thus gaining more heat from the material. Passed on to the boiler's fire room, the peat is dry, ready to be used for low-caloric fuel. The entire process takes between 10 and 15 min, the test plant yielding 260 kgs (572 lb) steam per hour.

Attempts to use peat in electric power production in the dual way of exploiting peat's inherent dampness and the dried remains as fuel, date back to 1899 when the German engineer, Gehrke, started tests. While continued for a long time, no really profitable processing technology has been devised until now, according to the Russian report.

Overseas Flashes

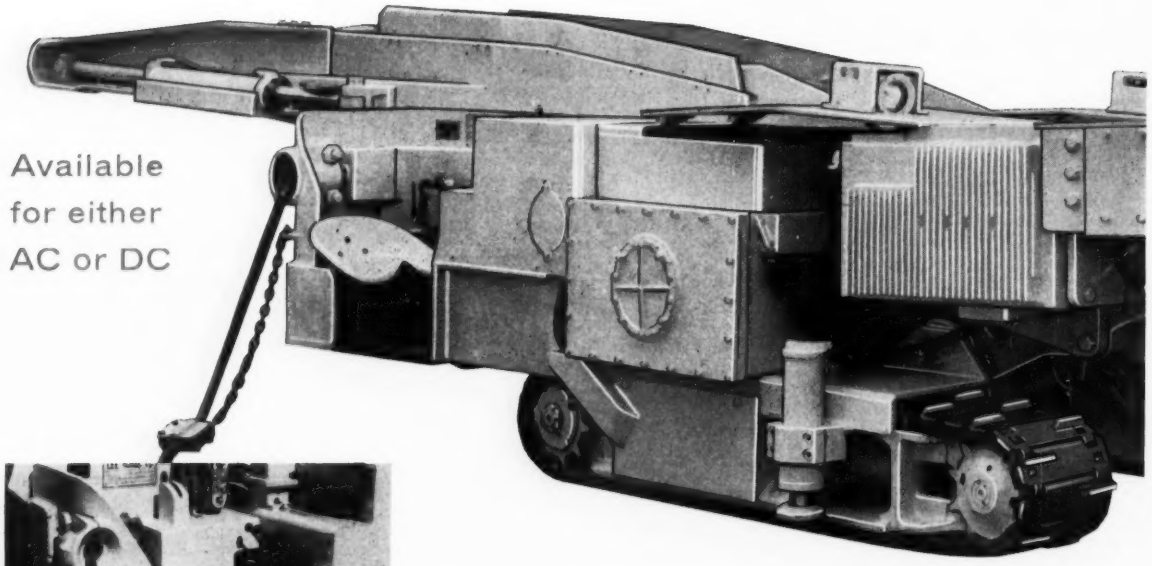
ECSC—Coal production in the six European Coal & Steel Community nations slipped by almost 5% in 1959 compared to 1958. Reasons included growing competition from oil, a slack market and mounting pithead stocks. Total ECSC production was 234,880,000 metric tons for 1960 against 246,390,000 for the year before. Germany produced 125,587,000 tons compared to 132,582,000 in 1958. Belgium production slipped from 27,062,000 tons in 1958 to 22,752,000 in 1960. French production was 57,592,000 tons, about the same as the year before. Italy and the Netherlands made slight gains, Italian production climbing to 738,000 tons from 721,000 and Dutch output to 11,964,000 from 11,880,000.

BURMA—The Defense Services Institute of the Burmese Army will set up a coal prospecting and mining company in partnership with Israel interests. The new concern, to be called United Coal Suppliers, will be controlled on a 55/45 basis by the Burmese Institute and the Israel group. The two countries set up a joint shipping company several months ago.

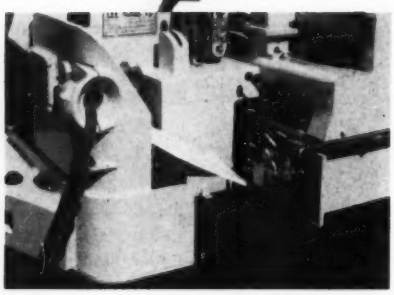
IRAN—A German-English consortium, including Demag, Krupp and Metallurgical Equipment Export Co., is preparing a bid for steel works in Iran complete with power station and coal and ore-mining facilities. The steel works would have a capacity of 200,000 tons, with coal and iron ore drawn from the Albruz Mountains.

USSR—Coal ignited by high-voltage current will provide more than 70 billion cu ft of gas, mostly for the Angrenskaya power station, from Russia's largest underground gasification plant recently placed in operation, Pravada reports.

LIGHTWEIGHT COST *plus* HEAVYWEIGHT *equals* PRODUCTION



Available for either AC or DC



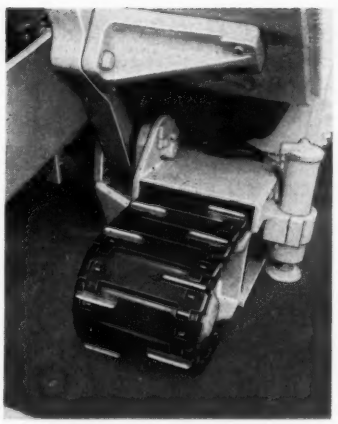
OPERATOR'S PLATFORM

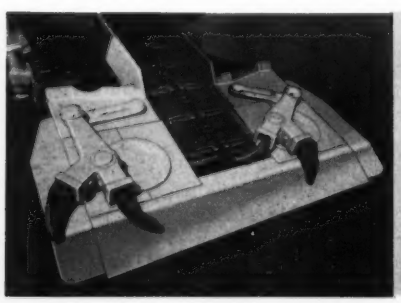
Compact and convenient hydraulic and electrical controls are within easy reach of the operator. Throttle valve precisely controls the speed of all hydraulic operations as well as providing "deadman" control.

16″ WIDE CRAWLER

The new crawler with heavy-duty gearing can operate the miner on steep grades and also float on soft bottom.

Less than 25 P.S.I. ground pressure.



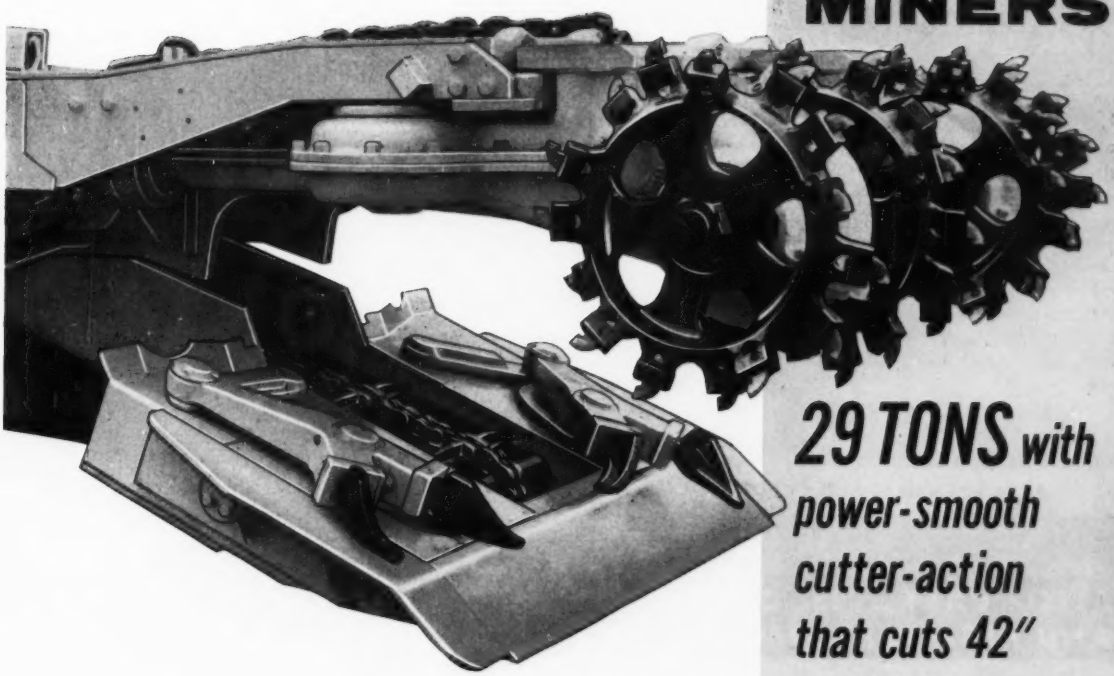


GATHERING HEAD

The exclusive "dual gathering arms" provide maximum reach and much better flow to the conveyor.

PERFORMANCE PUNCH

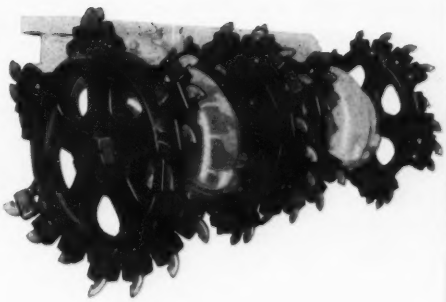
Lee-Norse CM38 and CM48 MINERS



29 TONS with power-smooth cutter-action that cuts 42" to 120" seams and gathers loads as fast as they are cut

CUTTING HEADS

New "Rap-Lok*" Cutter Bits, spaced evenly around cutter rim, provides smooth, vibrationless performance. Extremely quick "bit change"—no set screws—long bit life.



*Trade Mark of The Cincinnati Mine Machinery Co.

Lee-Norse Company

CHARLEROI, PENNA.

Specialists in Coal Mining Equipment

Coal high or low?... Lee-Norse MINERS keep production on the go!

News Roundup *(Cont. from p 28)*

Sanitation Compact; and

"WHEREAS: it has been demonstrated that the conscientious application of certain principles and practices will under certain conditions alleviate the pollution from acid mine-drainage;

"NOW, THEREFORE: In furtherance of the policy and procedures as above set forth and for the general purpose of contributing to the achievement of the objectives specified in Article I of the Ohio River Valley Water Sanitation Compact;

"BE IT RESOLVED: That the following measures are hereby adopted by the Commission for the control of acid mine-drainage pollution in the Ohio River Valley Water Sanitation District and pursuant to the statement of policy and procedures are to be followed by the signatory states:

"1.(a)—Surface waters and ground waters shall be diverted where practicable to prevent the entry or reduce the flow of water into and through workings;

(b)—Water that does gain entry to the workings shall be handled in a manner which will minimize the formation and discharge of acid mine-drainage to streams.

"2. Refuse from the mining and processing of coal shall be handled and disposed of in a manner which will minimize discharge of acid mine-drainage therefrom to streams.

"3. Discharge of acid mine-drainage to streams shall be regulated insofar as practicable to equalize the flow of daily accumulations throughout a 24-hr period.

"4. Upon discontinuance of operations of any mine all practicable mine-closing measures, consistent with safety requirements, shall be employed to minimize the formation and discharge of acid mine-drainage.

"5. Under appropriate circumstances, consideration shall be given to the treatment of acid mine-drainage by chemical or other means in order to mitigate its pollutional properties.

"Nothing stated in this control measure shall be construed to relieve any municipality, corporation, person or other entity from responsibility for compliance with existing federal, state and local laws and regulations."

Student Training

Pennsylvania State University is starting a student-trainee program for the summer of 1960 to supplement the regular four-year curriculum in mining engineering.

The new plan, explains Howard L. Hartman, head of the Mining Dept., has resulted from concern about the shortage of engineers entering the mining industry in contrast with the demand and opportunities for young men in this field. "A sharp decline in mining engineering enrollment at most universities during the past two years indicates the situation is growing steadily worse," he said.

The program is designed to benefit companies in the mineral industries by providing a steady supply of technical personnel. Trainees will be selected from the ranks of employees and recent high school graduates. They will attend school six months and work in industry six months, over a four-year period. Remaining in school continuously the fifth year, they will study a rearranged curriculum permiting them to obtain bachelor of science degrees within the 5-yr period.

Participating companies will provide employment to students for alternating periods as engineering trainees. To maintain job continuity, most firms will sponsor pairs of students so one student is working while the other is in college.

Nine companies reported as participants

FARRELL-CHEEK

ALLOY CAST STEEL MINE CAR WHEELS AND HIGH PERFORMANCE PARTS

MADE OF F 85 ALLOY CAST STEEL

Essential parts for every coal mining operation, cast from finest carbon and alloy steels.

Wheels and Rollers • Sheaves and Wire Rope Fittings • Chain, Sprockets and Buckets . . .

Far from ordinary, these highly specialized mine car wheels, electric furnace cast of F85 alloy steel, are establishing new performance and service life records in actual use. A Brinell of 350-400 is provided on treads and flanges with a high degree of ductile toughness in hubs and webs.

You'll want complete information on all F-C wheels and parts for coal mining. WRITE TODAY!

Finest Name in Cast Steel!

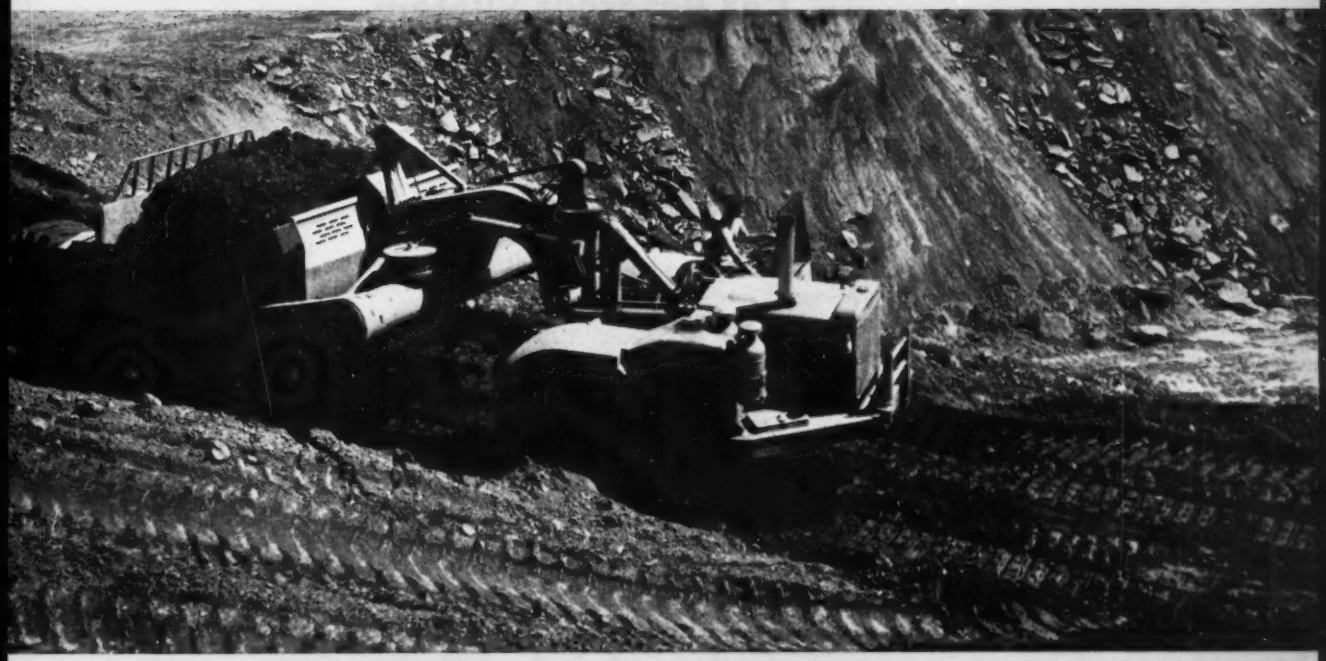
FARRELL-CHEEK STEEL CO.

106 LANE STREET, SANDUSKY, OHIO

OUR Fiftieth YEAR

F85 F-C

DW21s live up to...



A DW21 and No. 470 Scraper average 4½ minutes cycle time on 1,100 ft. haul.

and beyond production expectations

Stripping blocks of coal left next to abandoned underground mines is nearly always tough going, especially when it means moving material soaked with water from underground springs. Here's how the Gillen Coal Mining Company of Carbondale, Pa., solved the problem: with 180 ft. of overburden to remove, they assigned two Cat DW21 Tractors the job of removing 10 feet of topsoil and 100 feet of hardpan. The remaining 70 ft. of rock over the coal seam was removed by a 6-yd. shovel. With DW21s removing the upper portion, production increased and costs went down.

Tom Gillen, president of the company salvaging the coal, confirms the quality of these Caterpillar machines by stating: "The DW21s are even better than represented to us before purchase. We get high production because of low down time—ease of loading and unloading."

Working under these rugged conditions, the two DW21s equipped with No. 470 Scrapers and pushloaded by a Cat D9 Tractor followed the bench method of stripping and moved up to 4,000 yards a seven-hour shift, each yard weighing 3,200 lb.

Now, with the DW21 Series G even higher production records are possible. 345 HP enables it to deliver more rimpull and permits 20 per cent faster travel speeds under similar haul road conditions. Both the tractor and the No. 470 LOWBOWL Scraper have design and structural improvements to meet your needs for moving more dirt at a lower cost than ever: the tractors have stronger final drive gears and improved transmission shifter forks; scrapers have stronger bowls, draft frames, and aprons.

Pick your toughest job, then pick up your telephone and ask your Caterpillar Dealer for a profit-proving demonstration of these heavy-duty rigs. He backs you with round-the-clock service and parts you can trust. Call him now.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

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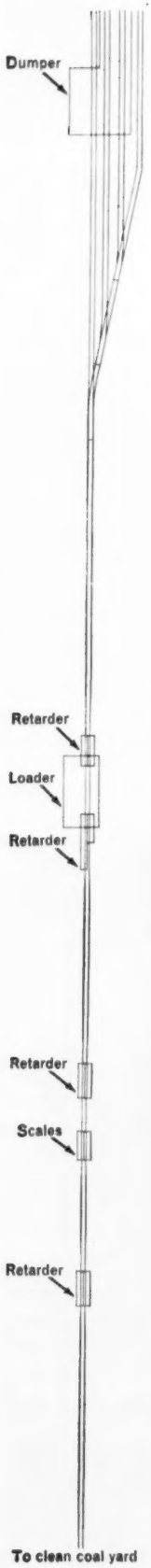
WANTED—
THE HARD WORK



720 tons of coal per hour loaded safely with Union Switch & Signal Car Retarder System

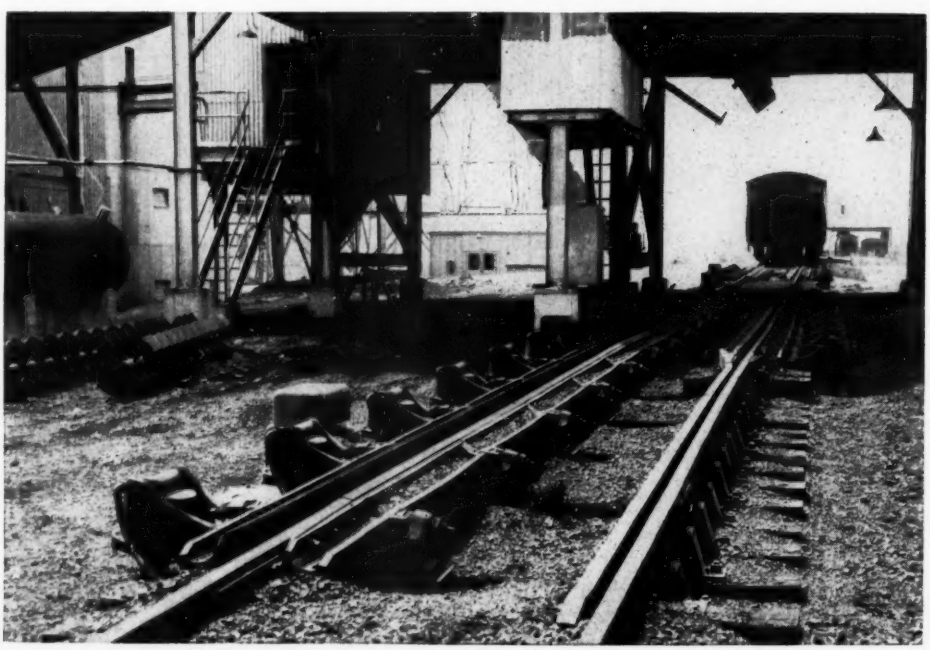
At U. S. Steel's coal cleaning plant, Corbin, Kentucky, a system of four car retarders is used to direct coal cars through loading, weighing and coupling operations. This Union Switch & Signal Car Retarder System places cars with speed and accuracy, eliminates a safety hazard and results in a substantial operating saving.

Empty cars are moved to the loading track where the pushbutton-controlled retarders take over while the cars are loaded. Cars next run by gravity to the retarders at the scale house, are weighed and then run by gravity to a collecting point at another retarder. The entire job is handled quickly and economically by two operators. In three years of operation, the system has been trouble-free and maintenance-free.

Let us help solve your car control problems. We will be happy to discuss with you—without obligation on your part—how a Union Switch & Signal Car Retarder System can speed up operations, promote efficiency, reduce safety hazards. Write today for more complete information.

The first retarder receives and controls empty cars before the loading. Under the loader the cars are slowed down by the second retarder, then move gradually to receive an even load distribution. The third retarder slows the loaded cars for accurate weighing. Just before the coupling, the cars are brought to a complete stop by the fourth retarder.

Empty cars moving to loader are controlled by first retarder, in background. This retarder arrangement provides for availability of 8 empty cars in advance of loading point. As loading progresses, second retarder, in foreground, controls movement of cars being loaded. This system of car handling moves cars with accuracy, assures a full, evenly distributed load.



UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY
SWISSVALE, PENNSYLVANIA
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NEW!

STANDARD Coal Spray Oils to give you these 5 Big Benefits

1. Four viscosity grades. There's an oil of the right viscosity for (1) the kind of coal you mine, (2) your application needs.

Grade	Saybolt Universal Viscosity at 100° F
Coal Spray Oil No. 60	600
Coal Spray Oil No. 100	1,000
Coal Spray Oil No. 150	1,500
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2. Hot delivery from Wood River, Ill. Anywhere within 200 miles of Wood River, Illinois, you can get truck transport quantities of STANDARD Coal Spray Oils delivered at high temperature. This means easier transfer, less heating to get to application temperature.

3. Good application qualities. STANDARD Coal Spray Oils can be applied easily by either the hot vapor spray or high pressure atomized cold spray methods. The oil adheres to coal and effectively binds particles that would otherwise dust.

4. Non-corrosive to coal handling equipment. No costly wearing out of handling equipment occurs when you use STANDARD Coal Spray Oils. There's no down time for repair and replacement of equipment.

5. Three valuable product benefits. (1) A clean, dustless product to sell. (2) A good, bright appearance to your coal after spraying. (3) Reduced windage losses in shipment.

For freeze-proofing coal, get Standard's WR 663½ Oil.

Get all the facts about STANDARD Coal Spray Oils and freeze-proofing oil from the Standard Oil office nearest you anywhere in the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

You expect more from STANDARD *and you get it!*

to date include: Climax Molybdenum, General Crushed Stone, Hanna Coal, Harbinson-Walker, Island Creek Coal Co. and Jones & Laughlin.

Black Mountain

What would you do if you had to find a way to use up a 2-million ton mountain of lignite? This is the problem facing the Army Corps of Engineers, which piled up the black mountain while excavating for the Garrison Dam, built across the Missouri River, near Riverdale, N.D., some 10 yr ago.

The lignite was taken from a 12-foot vein and the Army has been trying to get someone to take it off its hands ever since digging started. Efforts to dispose of the coal have proved futile, however. The North Dakota mining industry, which has an annual production of only between 2 and 3 million tons, resisted efforts to have it marketed because of the depressing consequences on the industry which would result. And, the coal is too low in heating quality to be economically shipped outside the immediate marketing area.

Ray of Light—The Army thought they had the problem solved last year when North Dakota Nitrogen Co., a good sized company, announced plans to use the lignite, which has the high oxygen-nitrogen content of 30 to 45%, to manufacture nitrogen fertilizer. Annual production was to be 170 thousand tons.

Hopes Dashed—However, shortly before 1959 ended, North Dakota Nitrogen announced abandonment of plans both to use the lignite and to build a plant at Riverdale. Instead, the company notified the Army Engineers, it will employ natural gas and will build a plant elsewhere where gas is available.

With natural gas, NDN president, George C. Van Nostrand said, the firm can produce nitrogen fertilizer less expensively and more efficiently than with lignite. Natural gas' use will eliminate financing problems and will save an estimated $1.5 million in construction costs alone, he said. However, Mr. Van Nostrand added, the company plans to continue its investigations into the use of lignite.

But for the Army Corps of Engineers, talk of more research on possible uses for their lignite white, or black, elephant, probably strikes an old, perhaps sour, note.

New Research Bill

A bill providing for a coal research and development program under a special office in the Dept. of Interior was approved at the end of January by the Mines and Mining Subcommittee of the House Committee on Interior and Insular Affairs.

National Coal Association president, Stephen F. Dunn, testified in support of the bill, No. 18, saying, "We believe the importance of a coal research and development program is such that it requires the establishment of an office in the Dept. of Interior directed to give special and exclusive attention to the problems involved." Mr. Dunn said early establishment of a "vigorous, aggressive, well-rounded research and development program" to maintain a strong, stable industry for national defense is more important than the agency through which it is received.

As reported by the Subcommittee, the bill authorizes the Secretary of Interior to contract for, sponsor and coordinate research with recognized interested groups, to establish technical advisory committees to assist in examination and evaluation of research, and to cooperate with other governmental and private

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FIRST OF ITS KIND! It's push-valve, non-stop. BIT LIFE UP TO TO 1
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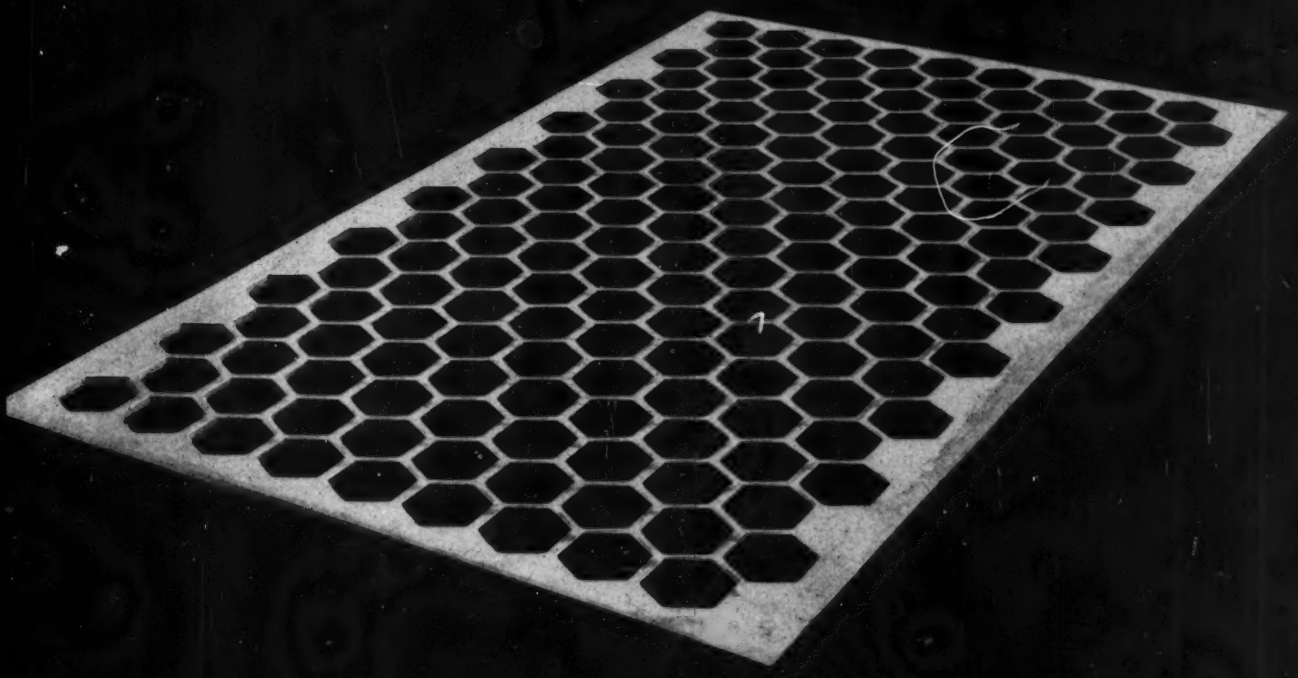

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Cross HEXCREEN* gives more uniform sizing, greater capacity

If you have been using woven wire screens or perforated metal screens with square or round openings, you will find that you can increase capacity, get more accurate sizing with CROSS HEXCREEN. The unique configuration of CROSS HEXCREEN (hexagonal shaped perforations), gives you more open area and less weight than equivalent square or round hole screens, yet provides the sizing accuracy of round type (see example at right).

CROSS HEXCREEN is specially designed for sizing granular products such as coal, coke, sand, gravel, crushed stone, slag, limestone, minerals and ores. CROSS perforated steel screens, made from long wearing CROSS Special Analysis Steel, are available in a wide range of sizes with uniformly spaced square, hexagon or round perforations, staggered for increased capacity and efficiency. For additional information on CROSS Perforated Screens write for complete catalog.

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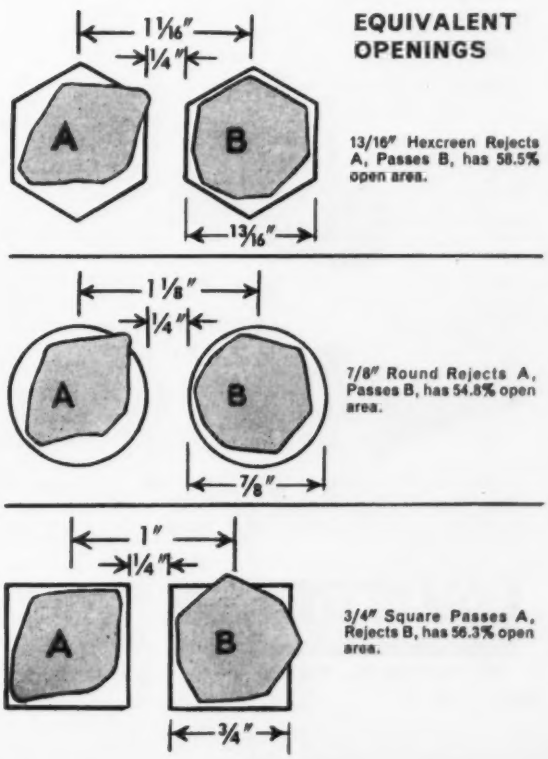

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Moderately priced!

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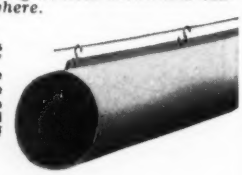
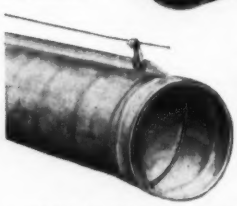
FLEXIBLE VENTILATION TUBING

One man can install it or take it down —weighs only a fraction of rigid metal pipe. As tough as a tire, because NEOLON is made of neoprene coated nylon fabric —almost impossible to tear or puncture. Can't be dented like metal pipe and costs much less. Easier to store. Most popular ventilation tubing in both metal and coal mines. *everywhere.*

Standard lengths — diameters 8" to 36". Choice of Demountable or Sewed-In Couplings and two types of suspension.





This new Wire-Reinforced NEOLON Tubing for pulling out foul air. Use with any exhaust fan or suction fan.

Made by the makers of ABC Brattice Cloth—the yellow brattice in 7 different types, ABC Inflatable Brattice, ABC Trolley Guards and ABC Powder Bags. Send for Catalog.

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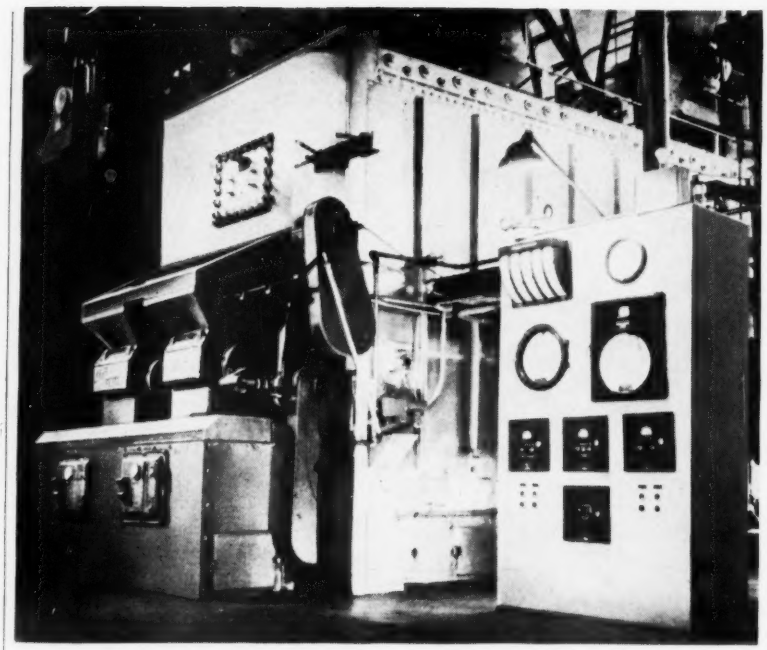

COAL-FIRED packaged steam generators are no longer restricted to low capacities, reports Foster Wheeler Corp., New York. The large manufacturer of industry equipment states that users of packaged generators have generally had to use gas and oil firing in all capacity ranges but the lowest. To meet this problem, its economic choice of packaged steam and power supply is offered in coal-fired units of substantial capacity, Foster Wheeler declares. Units are available in standard sizes of 43,000, 50,000 and 63,000 lb of steam per hour with pressures up to 250 psi. Under test conditions, the water-tube unit has operated continuously at 54,000 lb per hour with efficiencies of more than 80%, it is noted. Features include smokeless operation, flexibility in use of fuels and semi-automatic operation.

News Roundup *(Continued)*

agencies in coal research and development.

The Subcommittee amended the bill (H. R. 3375) by Rep. John Saylor (R-Pa.), to remove the program from control of the Bureau of Mines but leave it under the Secretary of Interior. The bill authorizes an appropriation of $2 million for the program in the fiscal year beginning July 1.

President's Plans—President Eisenhower, in a budget message to Congress, asked for legislation authorizing the Secretary of Interior to contract for coal research and development work. The President also proposes to spend $6,508,000 on bituminous coal research within the Bureau of Mines, including $250,000 for design and development of a stationary coal-burning gas turbine. This total is roughly comparable to amounts spent on research by the Bureau of Mines in previous years and does not include the $2 million proposed in the new research bill.

Bill Support—Those who presented testimony for the bill included: Assistant Secretary of Interior, Royce A. Hardy; Julian D. Conover, executive vice president, American Mining Congress; Joseph E. Moody, president, National Coal Policy Conference; Frank W. Earnest, president Anthracite Institute; and Reps. Elizabeth Kee (D-W. Va.), Carl D. Perkins (D-Ky.), W. Patt Jennings (D-Va.), Daniel J. Flood (D-Pa.), William H. Natcher (D-Ky.), Harley O. Staggers (D-W. Va.), Keith Thompson (R-Wyo.) James E. Van Zandt (R-Pa.) and Cleveland M. Bailey (D-W. Va.).

Some members of Congress expressed doubts about the usefulness of the bill. Rep. Kenneth J. Gray (D-Ill.) was quoted in press reports as saying the bill probably will not accomplish its purpose—but that he would still support it. "We'll take whatever we can get," he added. Some other Congressmen expressed similar sentiments.

Stored Gas

Public Service Co. of Colorado has moved a step nearer to emergency use of gas it has been storing in the abandoned Leyden coal mine 7 mi northwest of Arvada, Colo.

With installation of a compressor station completed at the site, officials said it is now possible to withdraw up to 15 million cu ft of gas daily to augment the

22288

How to get more cuts per shift

Extra cuts add up fast when you have a Goodman 2400 Series rubber tired cutter on the job. All positioning movements of its cutting element—boom, cutting head, swinging head and cutter arm—are smooth and fast, in response to finger-tip hydraulic controls. When the machine must be "slewed" to continue a cut, delay is momentary. Result—time saved per cut is substantial . . . more cuts per shift.

Goodman Cutters move anywhere in the mine. A 90" wheelbase permits full maneuverability, even in limited space. Speed and steering are hydraulically controlled. Two permissible type motors (AC or DC) power each machine. One drives the cutter chain exclusively, the other activates the hydraulic system that controls all other machine movements.

22295

There's a Goodman Loader and Shuttle Car combination to take full advantage of more cuts per shift.

As to cutting range, there are three machines—29", 40½" and 42" high—that top, center, bottom cut or shear with no blind spots from top to bottom or from rib to rib. Then there's a 29" high machine that can be arranged for either top or bottom cutting.

Maintenance costs run unusually low. At one property, for example, eight 2400 series cutters were operated on a 3-shift basis for 15 months at an "all-maintenance" cost per ton figure that was lower than that for any other face equipment in the mine.

So to get more cuts per shift, at low cost—put a Goodman 2400 Series machine to work in your mine. Write today—request Catalog G-138.

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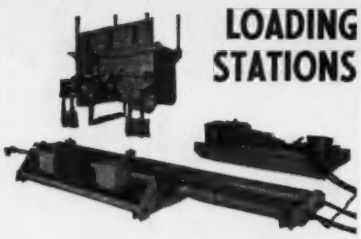

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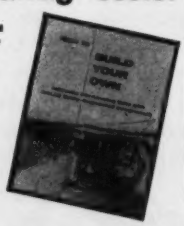

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News Roundup *(Continued)*

Denver area gas supply in event of a sub-zero weather emergency.

Engineers have installed the last of three huge Worthington compressors about one-half mile east of Leyden, thus completing the necessary machinery to suck the gas from the mine into temporary gas lines.

Success—All indications to date are that the conversion of the old coal mine into a storage vault for some 3 billion cu ft of natural gas has been successful. Public Service Co. decided to take its big gamble on conversion of the mine back in 1958. The project is believed to be the first arrangement of its type and has attracted world-wide interest among mining and petroleum engineers.

Tests Look Good—Testing of the mine has given satisfactory results thus far and continues on schedule, PSC engineers report. Well No. 4 in the newest section of the mine, which is 50 ft below the older workings, has been completed and the gas line to it installed. This new well will be used to vent out the dead air and other gases as natural gas is foreed into the huge cavern.

Gas injections into Well No. 3, the old section of the mine, have been holding, indicating that portion is gas-tight, the engineers said. The Leyden lignite mine produced some 6 million tons of coal while it was in operation from 1903 to 1950. The operations left a cavern of about 150 million cu ft. It has been estimated that 3 billion cu ft of natural gas can be stored in the area under a pressure of 300 lb per sq in.

Time, Money—It is expected the complete testing will require several more months before the mine can be filled to its capacity. The testing phase will cost about $352,000, and, if the test prove satisfactory, the additional development work will require about $5,217,000, PSC engineers estimate.

Mines, Companies

More than 700 miners are expected to find work in two new coal mines to be opened in Franklin County, Southern Illinois, in 1960.

Hoisting of coal on a small scale has begun at Old Ben No. 21, where construction is close to completion. This new property, owned and operated by Old Ben Coal Corp., is the county's first new mine to be opened since the end of World War II, according to reports. Another new deep shaft mine is being completed 3 mi east of Benton, Ill., by Freeman Coal Co. It has been named Orient No. 5. Both mines tap the No. 6 vein running through Franklin County. Old Ben No. 21 went on the drawing board in 1924, but depression and lost markets resulted in its shelving until 3 yr ago when ground was broken for a main shaft and auxiliary shaft. Orient No. 5 was started in May of last year to recover vast coal deposits sealed off by a 1951 explosion in Orient No. 2, which killed 119 men.

The Pittston Co. recently completed negotiations for sale of its Lillybrook Coal Co. Div. to the Pocahontas Land Corp. Sale price was not disclosed.

The Pocahontas Land Corp., a subsidiary of the Norfolk & Western Ry., purchased all capital stock of Lillybrook. The transaction involves 15,000 acres of land and the Killarney, Lillybrook and Affinity mines in Raleigh County, W. Va. The three mines have not operated in recent months. The transaction also included the Twin Branch Coal Co. property of 5,500 acres, acquired by Pittston about three years ago from Jones & Laughlin Steel Corp.

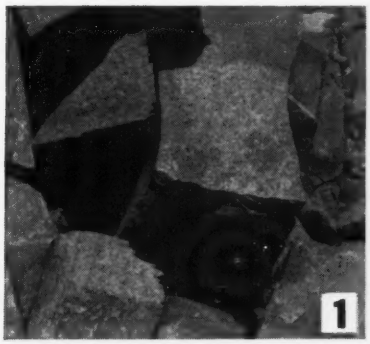
H. J. Ubring, of Clarksburg, W. Va., vice president of the Electric Machine & Supply Co., announced recently he had purchased the abandoned Allegheny mine of the Blue Diamond Coal Co., at Hellier, Pike County, W. Va.

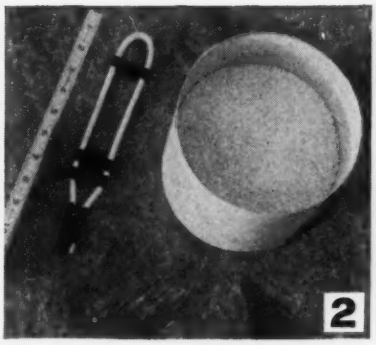
Mr. Ubring said the equipment, including tipple, machinery, rails and coke ovens would be dismantled and sold. The mine was sold in 1956 to Blue Diamond, which operated it until November, 1959. At that time, it had 200 employees and was producing about 1,500 tons of coal and 325 tons of coke a day. A statement at the time it was closed said the mine was no longer profitable to operate, although it still had coal reserves.

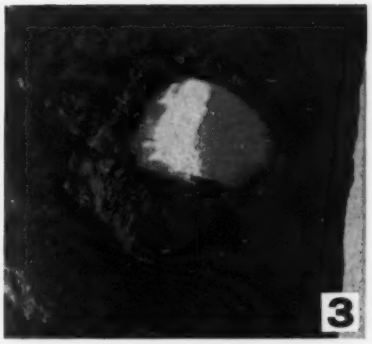
Utilization

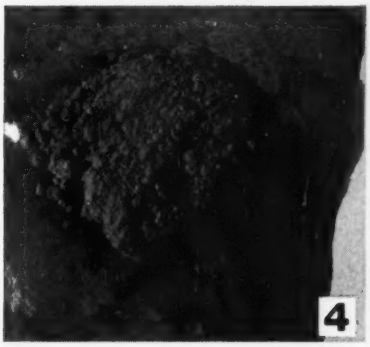
Harry S. Patrick, president of the Roslyn Cascade Coal Co., of Kittitas County, Wash., issued a statement in defense of Washington Governor Rosellini's plan to use coal instead of natural gas at state institutions.

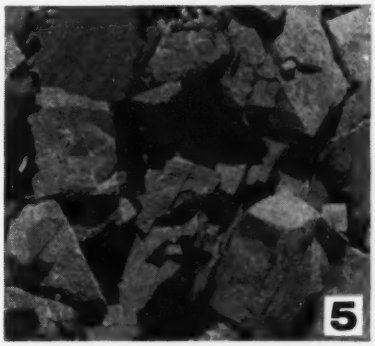
Mr. Patrick noted that an 8-man committee appointed by the governor had reviewed the situation before the change was made and concluded it was to the state's advantage. Mr. Patrick issued his statement as a reply to reports by examiners for the state auditor that it cost upward of $37,000 more a year to operate the Lakeland Village institution near Spokane, Wash., using coal instead of gas. Mr. Patrick indicated that there was more involved than just final fuel cost. He said the governor's decision considered the livelihood of Washington miners and their families, state taxes paid by the coal industry, contributions by the industry to the state industrial insurance and unemployment compensation and the mines' purchase of supplies representing further taxable income to the state.











1. Basalt boulder prior to blasting.
2. Spencer N-IV and 6% diesel #2 fuel oil plus 20" of 175-grain detonating cord.
3. N-IV-fuel oil mixture being placed on boulder.
4. View of completed "mudcap."
5. Boulder after blast.

"Mudcapping" Now Possible With Ammonium Nitrate-Fuel Oil Mixtures:

Another example of Spencer Chemical Company's continued research in the blasting field

The pictures above show another example of how Spencer research is finding new and better ways for using Spencer N-IV Ammonium Nitrate-fuel oil mixtures in blasting operations. Using the same basic materials and preparation used in blasting bore holes, it is now possible to do "mudcapping" for breaking up large boulders.

The Spencer N-IV Ammonium Nitrate used for each blast is put in an ice cream container and mixed with 6% diesel #2 fuel oil. The material is set on the boulder and dirt is packed around it. The charge is initiated with a loop made from 20 inches of 175-grain detonating cord.

Whether you use Spencer Ammonium Nitrate N-IV and fuel oil mixtures for "mudcapping" or for blasting bore holes, you'll find that Spencer N-IV as an ingredient in blasting agents produces more energy than competitive grades of ammonium nitrate. That's because Spencer N-IV has a special structure that lets the prills absorb oil more easily, and N-IV contains a higher percentage of ammonium nitrate.

Yet, Spencer N-IV Ammonium Nitrate costs you no more than other brands!

Spencer Chemical Company also has available a machine scientifically designed for placement of N-IV-fuel oil mixtures into horizontal blast holes. Called the Spencer Powder Monkey, this unique device eliminates tamping bags, tamping equipment, or the labor needed to fill and tamp bags into the hole.

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News Roundup (*Continued*)

While research designed to help the anthracite industry in Pennsylvania has been under way for many years at Pennsylvania State University, the program has been intensified in recent years.

A coal research section was organized three years ago to better coordinate activities in this area. Dr. William Spackman Jr., serves as director of the section, assisted by Russel R. Dutcher and other research personnel. The section works primarily as a research agency for the Coal Research Board, a state agency established to seek new markets for coal and new methods to increase the utilization of Pennsylvania's natural resources. Grants to the research section from the Board durnig the last 3 yr have totalled more than $386,000 with $199,500 of this amount earmarked for anthracite research. Scientists at Penn State are currently studying effects of atomic radiation on anthracite. It is believed that it may be possible in this way to alter the coal structure and in this way develop new uses for it. The grindability of anthracite, and blending for the production of coke are other studies—the scientists currently have in process.

Work is continuing on use of powdered Colorado coal in diesel fuel.

The Denver & Rio Grande Western Ry. laboratory has already done extensive research work. In 1955, the railroad sent samples of crushed coal to Brookhaven National Laboratory for gamma radiation under a contract with the Atomic Energy Commission. This nuclear bombardment reduced the coal into particles small enough to be dispersed in fuel oil. The powder-like coal particles remain in suspension when mixed with diesel fuel, researchers say. Ray McBrian, Rio Grand director of research, points out that there is no residual radiation in the fuel and consequently, no danger.

The Kentucky Dept. of Economic Development has announced award of a contract to the University of Louisville Institute of Industrial Research for a 6-mo study to consider advantages of nuclear radiation in chemical reactions leading to new uses of Kentucky coal.

Robert Solomons, director of the Nuclear Information Div., said the study is to determine the products obtained when coal is reacted with such materials as ammonia, nitrogen, chlorine, fluorine, steam, hydrogen, oxygen, olefine and mixtures of these gases. The contract is part of a large-scale effort of the department and the Kentucky Advisory Committee on Nuclear Energy to use unique research characteristics of nuclear energy to aid the coal industry in developing new products and markets.

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GENUINE JOY PARTS AVAILABLE AT 11 LOCATIONS
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JOY MANUFACTURING COMPANY
BRANAGAN
962

Bituminous Output

YEAR TO DATE	PRODUCTION
Jan. 16, 1960	18,310,000
Jan. 17, 1959	18,262,000

1960 output 0.3% ahead of 1959.

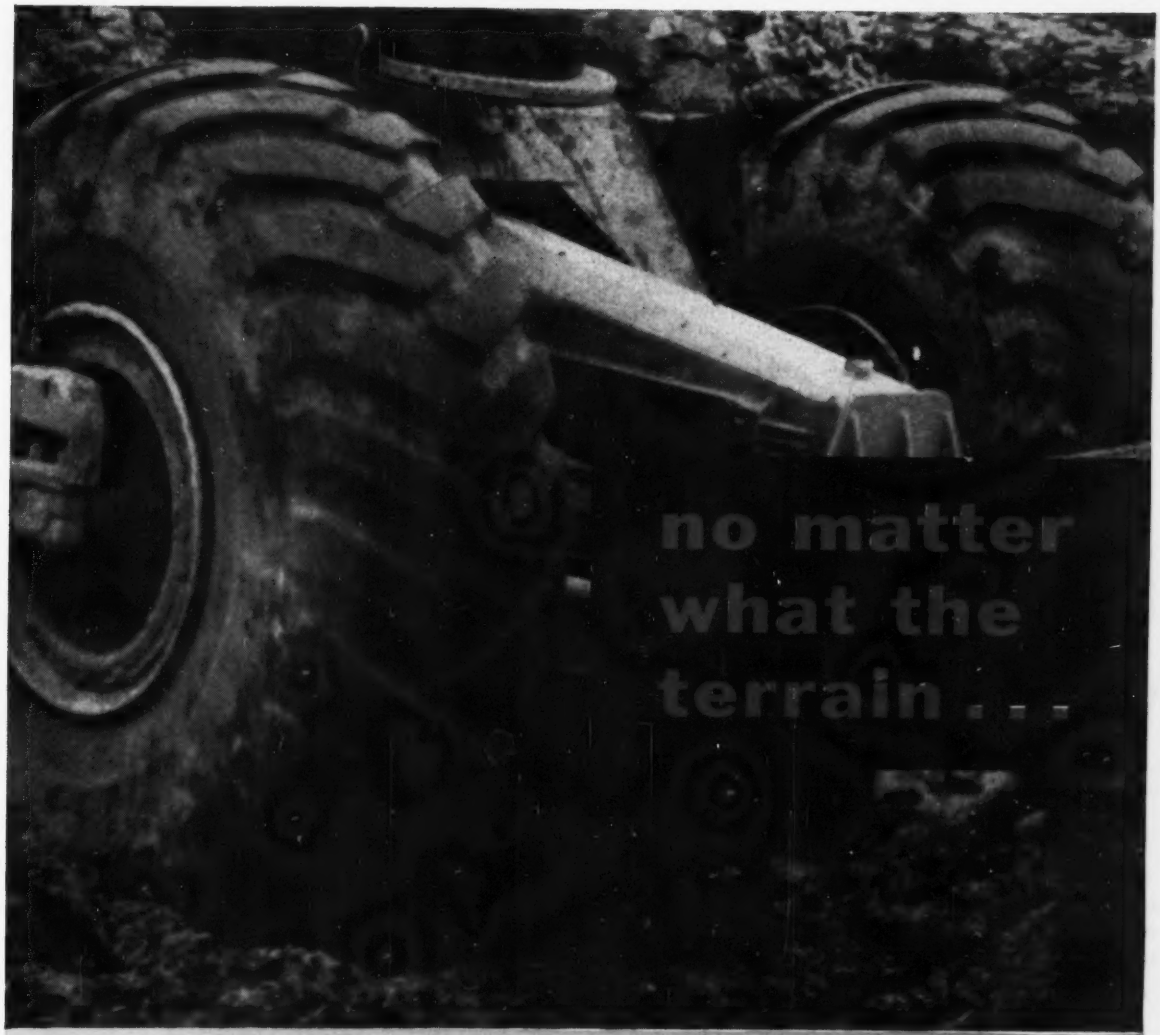
WEEK ENDING	PRODUCTION
Jan. 16, 1960	8,825,000
Jan. 17, 1959	8,290,000

Anthracite Output

YEAR TO DATE	PRODUCTION
Jan. 16, 1960	841,000
Jan. 17, 1959	1,231,000

1960 output 31% behind 1959.

WEEK ENDING	PRODUCTION
Jan. 16, 1960	440,000
Jan. 17, 1959	587,000



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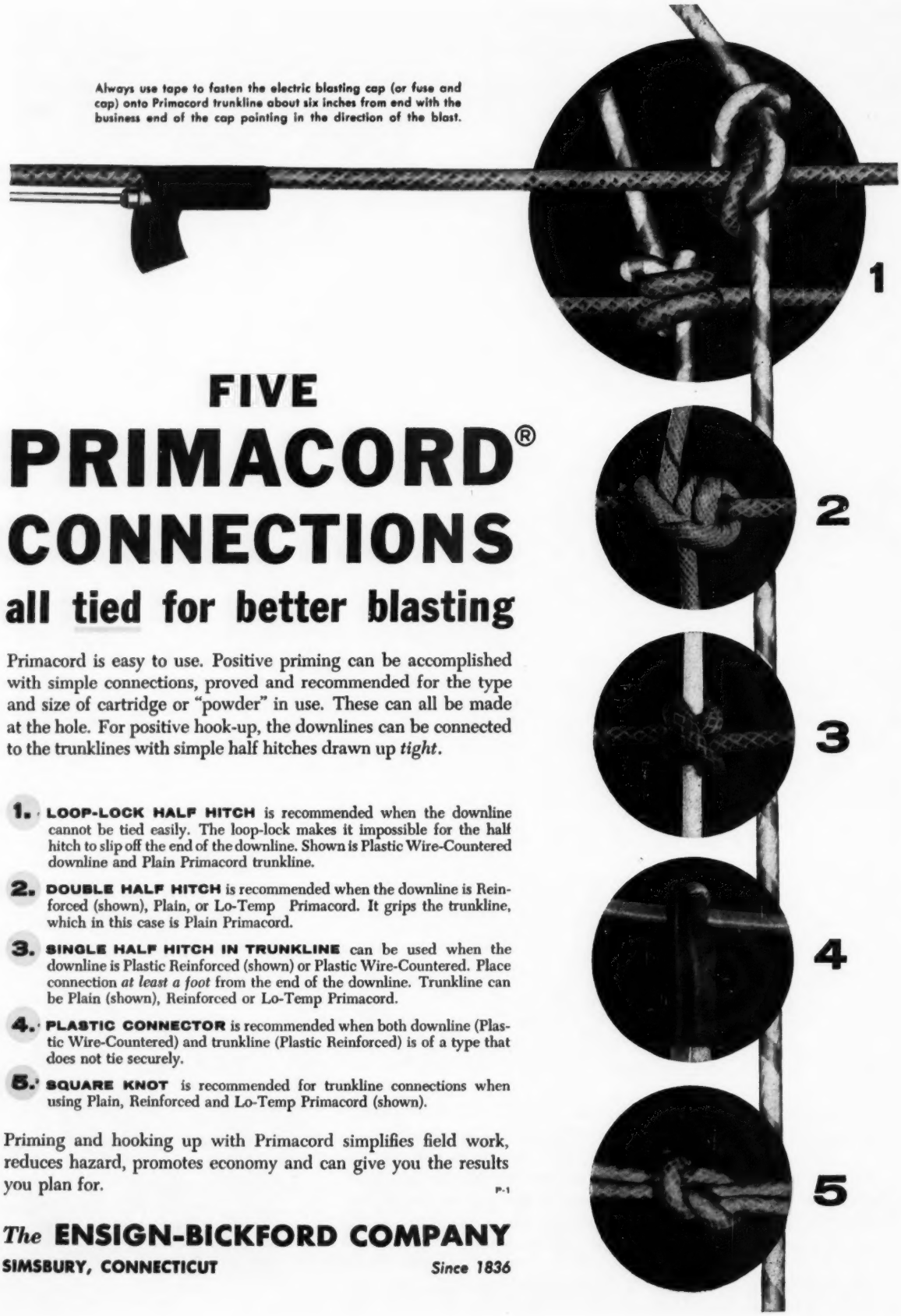
GENERAL TIRES

keep your units moving full steam hour after hour . . . job after job . . .

Whether it's sand, mud or the rockiest grade . . . the General Tire keeps rolling to keep projects on schedule. With exclusive Nygen-cord construction, the General Tire defies the worst job hazards while its heavy, husky tread provides traction beyond comparison. You get maximum flotation, minimum rolling resistance, too! That's why the tough-built General Tire keeps going whatever the going! See for yourself on your next job!

THE GENERAL TIRE & RUBBER CO. Akron, O.

Always use tape to fasten the electric blasting cap (or fuse and cap) onto Primacord trunkline about six inches from end with the business end of the cap pointing in the direction of the blast.



FIVE PRIMACORD® CONNECTIONS

all tied for better blasting

Primacord is easy to use. Positive priming can be accomplished with simple connections, proved and recommended for the type and size of cartridge or "powder" in use. These can all be made at the hole. For positive hook-up, the downlines can be connected to the trunklines with simple half hitches drawn up *tight*.

1. **LOOP-LOCK HALF HITCH** is recommended when the downline cannot be tied easily. The loop-lock makes it impossible for the half hitch to slip off the end of the downline. Shown is Plastic Wire-Countered downline and Plain Primacord trunkline.
2. **DOUBLE HALF HITCH** is recommended when the downline is Reinforced (shown), Plain, or Lo-Temp Primacord. It grips the trunkline, which in this case is Plain Primacord.
3. **SINGLE HALF HITCH IN TRUNKLINE** can be used when the downline is Plastic Reinforced (shown) or Plastic Wire-Countered. Place connection *at least a foot* from the end of the downline. Trunkline can be Plain (shown), Reinforced or Lo-Temp Primacord.
4. **PLASTIC CONNECTOR** is recommended when both downline (Plastic Wire-Countered) and trunkline (Plastic Reinforced) is of a type that does not tie securely.
5. **SQUARE KNOT** is recommended for trunkline connections when using Plain, Reinforced and Lo-Temp Primacord (shown).

Priming and hooking up with Primacord simplifies field work, reduces hazard, promotes economy and can give you the results you plan for.

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***The* ENSIGN-BICKFORD COMPANY**

SIMSBURY, CONNECTICUT *Since 1836*

Devoted to the Operating, Technical and Business Problems of the Coal-Mining Industry

COAL AGE

FEBRUARY, 1960

IVAN A. GIVEN, EDITOR

The Soaring Sixties

Beyond the benefits flowing out of a welcome increase in bituminous tonnage, coal in 1960 can feel happy over the fact that the immediate and farther future—the 60's and 70's—is one of steady, solid growth. This is true even though further losses will be experienced in certain markets. Overseas exports, for example, will continue to drop and eventually might even reach the low levels of pre-World War II. And home use must be counted as a declining direct outlet for anthracite as well as bituminous—at least for a time.

Two makes for a short list of declines, however, though some would add a third—the general industrial market. But if it is considered that direct tonnage losses, either actual or possible, may be offset in part or completely—and even more than completely—by coal in another form, such as electricity, the loss list gets shorter. At the same time coal continues to pick up momentum in the utility and steel markets, and quite possibly can show gains in general industry. In fact, one of the major hopes for anthracite is continued development of industrial, commercial and metallurgical outlets, not to mention chemicals and gas.

It would be foolishly optimistic to assume that coal could not be challenged or suffer a reduction of opportunity in its Big Three markets. A lot of research is going into improving the efficiency of present processes and developing new ones that might reduce coal consumption in metallurgy, power generation, and the production of process steam and heat for commerce and industry. But gains come hard, as recent years have shown, in developing competitors for the old reliables, while coal has a very real advantage as a low-cost source of large hunks of energy—an advantage it can continue to build on. Technology breakthroughs are few and far between, and there is nothing in the picture at the moment to indicate that coal will face any serious new challenge for some years, if ever.

Oil, gas and hydro will continue to be coal's principal competitors in the foreseeable future. But this will not necessarily be true forever. Coal can be made into good liquid fuel and good gas, and the only reason it isn't is the present high cost of conversion. But the pressure on competitive prices is upward, while conversion cost will drop. So coal may have a chance at the business of making liquid fuel and pipeline gas perhaps sooner than one might think.

Some have tagged the next decade as "The Soaring Sixties." There is no question but that it will be a period of growth—in population, industry and commerce. The demand for energy will jump correspondingly and coal is in the best position in years to capitalize on it—if it does what it already knows it should do. The increased tonnage of 1960 is only the beginning.

ELECTRIC HEATING offers immediate opportunity to recover lost retail tonnage. In '59, power plants burned 6.8 million tons of coal to heat 621,000 residential, commercial and industrial buildings. Forecast for '60: 8 million tons.

1960: Kick-Off Year For a Decade of Growth

Expected new peaks for bituminous use this year by electric utilities and steel should set the stage for growth in the '60s. Hard coal pegs growth prospects to commercial and industrial tonnage.

HARD-HIT by deeper-than-expected recession in '58 and a severe 4-mo steel strike in '59, bituminous entered the new year and decade poised to resume its growth destiny. Anthracite, continuing the leveling-off trend of recent years, pinned its future hopes to increased tonnage in commercial and industrial markets (see panel).

Forecasters known to *Coal Age* are unanimously agreed on the prospect of bituminous recovery, with differences only in degree. Estimates for 1960 range from 430 to 460 million tons. Last year output reached an estimated 410 million tons, and in 1958, the same.

A substantial rebound for bituminous in the current year assumes another record consumption by electric utilities—182 to 190 million tons, or 14 to 20 million more than 1959.

A rebound also assumes that steel production will reach a record 130 million tons in 1960. At this level, coke plants and steel mills should consume about 125 million tons of coal—36 million tons more than last year and a new peak in steel use of coal.

Big gains in use for making electricity and steel will be partially offset by losses expected in "other industrial," retail and export markets. A *Coal Age* breakdown of tonnage for major consuming categories shapes up as follows:

	Millions of Tons		
	Est. **1960**	Est. 1959	1958
Electric utilities	**186**	168	153
Steel (coke plants & steel mills)	**125**	89	84
Industrial (other mfg., cement, railroad)	**80**	83	94
Retail	**25**	28	36
Total U. S. Consumption	**416**	368	367
Canada	**12**	13	12
Overseas	**20**	25	38
Total Consumption inc. export	**448**	406	417

In spite of pay rates $2 per hr higher on April 1, 1959, *Coal Age* figures the average mine price of bituminous dropped from $4.86 in 1958 to an estimated $4.75 last year (USBM estimate: $4.86). The result was a profits squeeze for many producers although some did quite well. However, with firm prospects for stronger demand in big tonnage markets, industry analysts looked for some general upward movement in 1960 prices and a general strengthening of the profits structure.

Other 1959 developments worth watching this year include the following:

1. Industry management, through formation of the National Coal Policy Conference and reorganization of the National Coal Association, initiated a drive to fight competition more aggressively through improved marketing and merchandising.

2. Bituminous Coal Research reported an increasing number of co-

Anthracite Outlook: Production Leveling Off; Commercial and Industrial Markets Show Promise

USBM preliminary estimates put last year's total anthracite production at 19.5 million tons, compared to 21.1 and 25.3 million tons in 1958 and 1957, respectively. In spite of the 8% output-drop in 1959, industry spokesmen point to a continuing leveling-off trend for the following reasons:

1. **A recent USBM study** showed that sales to U. S. and Canadian markets for the 12-mo period ending Oct. 31, 1959, were only 2% less than sales during the preceding 12-mo period.

2. **A major part of the drop in output** during the past 3 yr could be accounted for by the sharp dive in overseas shipments which fell from 2.2 million tons in 1957 to an estimated 336,000 tons last year.

The Anthracite Information Bureau presents other highlights of the current hard-coal picture as follows:

"With annual retail sales of about $500 million, anthracite continues to be an important economic factor and a major fuel source, supplying heat for more than 2.5 million families and thousands of institutional and commercial buildings in northeastern United States, its primary market.

"Since the majority of anthracite's tonnage and dollar sales are derived from space heating, the industry is particularly encouraged by steadily increasing sales of automatic anthracite equipment. Sales of residential heating units in 1959 rose about 15% over 1958. In the last 4 yr, sales of automatic equipment for apartment houses, schools and other buildings have increased more than 300%. Based on existing orders, there is every indication that sales of automatic equipment for commercial space heating will reach an alltime peak in 1960.

"Significantly, the proportion of smaller anthracite sizes increased once more in 1959 and represented more than 50% of total industry sales. Smaller sizes are used in automatic anthracite equipment for residential and commercial space heating and also for industrial purposes. Sales to the steel industry were greatly reduced during the strike period; otherwise it is felt that total sales of smaller sizes might well have shown an increase over 1958.

"In the industrial field, use of anthracite for power generation, the manufacture of coke, pelletizing of taconite ore and sintering of iron ore continues to increase at a gratifying rate, according to the Anthracite Institute. About 3 million tons were used for power generation and the manufacture of coke in 1959. It is estimated that metallurgical uses now account for almost 2 million tons annually.

"A sizeable research program on anthracite is being conducted by the Federal Government through the USBM. The Coal Research Board of the Commonwealth of Pennsylvania has also authorized an extensive research program which is being conducted by the College of Mineral Industries of Pennsylvania State University. These research programs include work on utilization as well as mining methods.

"Increasing public concern about air pollution also promises to exert a favorable influence on anthracite sales. As the only inherently smokeless fuel, anthracite is being recommended, and, in some instances, specified by city officials in smoke-abatement programs. New legislation and stricter enforcement of regulations by several eastern states are highlighting anthracite's role in air pollution control."

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operative programs with industry-affiliated groups and substantial gains in field-testing of utilization equipment.

3. Two proposals for pipeline projects and an increasing trend toward barge movement of coal made news while railroads fought stiffening transport competition through greater ICC-approved rate-making freedom.

4. After 40 yr as head of the organization, John L. Lewis announced his intention to resign the UMWA presidency. His successor is Vice President Thomas Kennedy.

5. In public power policy, passage of H. R. 3460 gave coal an outstanding gain by incorporating limits to TVA territorial expansion; other bills proposed and resolutions passed aimed at building a framework for potential gains in solving unemployment problems, in curbing unfair competition, in advancing industry safety, in alleviating car shortages, and in facilitating mine modernization and expansion through a higher depletion allowance.

The following pages give more detailed analysis of bituminous markets and further highlights of industry problems and progress. The panel (p 76) provides a timely roundup of world coal trends.

Bituminous Markets

COMPETITION: Striking Harder

Both oil and gas, striking harder at coal markets, continued sales growth last year and looked forward to greater prosperity in 1960.

In December, the American Gas Association estimated that total sales of natural gas would run 8.8% higher in calendar-year 1959 than in 1958. Industrial sales climbed about 11.1% last year compared to a 0.4% jump in 1958. Estimates were based on the following data for 12-mo periods ending Sept. 30:

	Millions of Therms		
	12 Mo to 9/30/59	12 Mo to 9/30/58	% Change
Residential..	27,561.1	26,290.0	+ 4.9
Commercial.	7,745.7	7,289.9	+ 6.3
Industrial...	44,303.1	39,878.0	+11.1
Other.....	4,036.7	3,471.0	+16.0
Total.....	83,652.6	76,907.9	+ 8.8

Bolstering the cause of future growth in natural gas sales was FPC's OK on imports of the product from Canada into Midwestern states (*Coal Age*, December, 1959, p 27). Canada's National Energy Board, starting sessions last month, was expected to rule favorably on exports.

In another development, the Supreme Court, reversing a previous FPC decision, approved Transcontinental Pipeline Corp.'s application to deliver natural gas to Consolidated Edison of N. Y. (*Coal Age*, December, 1959, p 28). The same court,

How the Top 15 Coal-Producing Groups Ranked in 1951

Compiled by KEYSTONE COAL BUYERS MANUAL, A Coal Age Affiliate

Group or Company	1959 Tonnage	% Change 1958 to 1959	1958 Tonnage	% Change 1957 to 1958	Standing 1959	1958	1957	1956
Consolidation Group*	31,019,548	+10.8	27,988,182	−19.9	1	1	1	1
Peabody Group (1)*	25,698,844	+15.5	22,228,696	− 4.1	2	2	2	3
U. S. Steel (c)	15,046,987	−10.3	16,772,468	−27.4	3	3	3	2
Island Creek (2)*	13,297,942	+27.2	10,457,461	−24.5	4	4	4	4
Pittston Group*	12,623,648	+24.8	10,115,380	−20.1	5	5	6	6
Eastern Gas & Fuel*	9,568,699	+ 0.2	9,475,265	−20.5	6	7	7	5
Bethlehem Steel (c)	8,450,624	−16.2	10,085,970	−24.1	7	6	5	7
Traux-Traer (3)	6,962,804	− 3.5	7,214,301	− 8.8	8	8	8	9
Freeman	6,858,695	− 0.1	6,868,737	− 0.5	9	9	9	11
North American Group (4)*	6,347,338	+19.2	5,325,554	−13.2	10	12	11	12
West Kentucky Group*	5,932,870	+ 3.5	5,723,692	−12.2	11	10	10	10
Ayrshire*	5,731,459	+ 0.2	5,721,079	− 1.0	12	11	12	13
Old-Ben*	4,556,392	+ 3.2	4,411,800	− 7.5	13	15	16	17
Rochester & Pittsburg*	4,461,736	+ 6.9	4,170,792	−13.6	13	17	15	16
Pittsburg & Midway*	4,391,364	+11.6	3,936,051	+ 7.8	15	19	24	29
Totals	160,948,950	+ 6.9	150,495,428					

(c)—Captive * Companies with an increase
(1)—Includes Sunnyhill Coal Co. from 9/59, also Maumee Collieries Co. from 12/59
(2)—Includes Guyan Eagle Coal Co. from 4/59
(3)—Excludes West Virginia properties from 9/59
(4)—Includes Warner Collieries Co. from 11/59

The industry's top 15 producing organizations mined 160,948,950 tons in 1959, 39.2% of the total bituminous and lignite production in the U.S.A. Eleven of these companies showed increases over 1958.

The percentage of the total produced by the top 15 has increased every year in the 1950's, ranging from 21.7% in 1950 to this new high of 39.2% in 1959. Every indication points to a continuation of this trend.

One newcomer appears in the "Top 15" this year, Pittsburg & Midway Coal Mining Co. The record shows that this company has made consistent tonnage gains over recent years.

however, subsequently directed FPC to restudy Transco's contract with 26 producers before approving huge new sales from the group to N. Y. and other Eastern Seaboard areas.

Compared to 1958, domestic demand for all oils during the first 9 mo of last year moved up 5.5% from 2,407 to 2,541 million bbl. Of special interest to coal were continuing high imports of residual oil, as shown by the following data supplied in December by USBM and the American Petroleum Institute:

	Thousands of Bbl 1959	1958	% Change
Jan.-Sept.	165,780	126,317	+31.7
Oct.	13,919*	16,554	+19.4
Nov.	18,450*	15,960	+15.0
Dec.	25,460*	23,064	+10.4
Total	223,609*	181,895	+23.1

* Estimated.

Effective April 1, 1959, President Eisenhower proclaimed mandatory curbs on oil imports, including the residual product (*Coal Age*, April, 1959, p 26). The quota on residual, set high at a daily average of 363,000 bbl, was raised in December to 425,000 bbl. The shift from voluntary to mandatory controls, accompanied by rising imports, left little ground for flag-waving by coal in terms of recovering lost tonnage.

The nuclear front was relatively quiet. At its annual meeting last June, AEC noted an important gain in "restraining subsidization of atomic generated atomic power."

Worth watching in the competitive arena, a battle is shaping up in the coal-led drive to establish a national fuels policy. Judging by initial Congressional hearings last October, the outcome is problematical as coal and competitive-fuel spokesmen are already divided on motives, and energy-resources experts on the need, for a national fuels program (*Coal Age*, January, 1960, p 72).

ELECTRIC UTILITY: 190 Million Possible in '60

For the eleventh consecutive year, electric utilities posted record use of bituminous. Consumption in 1959 reached an estimated 168 million tons, up 10% from the previous year. Another record—ranging from 182 to 190 million tons—is in the cards for 1960.

Defining growth in utility-use of coal, *Keystone Coal Buyers Manual*, a *Coal Age* affiliate, states in part:

"All coal-burning regions will show increases, with the largest percentages showing up in the Mountain and East South Central Regions, and the lowest in New England, South Atlantic and West North Central Regions . . .

"Long-term predictions for 1965 show some change in growth rates, favoring oil, with gas and oil leveling off somewhat. Fuel use by 1965 is predicted at 248 million tons for coal, 98 for gas and 30 for oil, representing annual growth rates over the next 5 yr of 9% for oil, 8% for gas and 7% for coal." Predictions—based on replies from electric utilities accounting for 35% of coal-burn, 32% of gas-burn and 15% of oil-burn—are practically the same as those resulting from surveys in 1957 and 1958.

Last year, in one notable case of growing coal-based power in the west, Pacific Power & Light Co. opened its Dave Johnston plant at Glenrock, Wyo. The new station is the first of a group of four 100,000-kw units planned for the area (*Coal Age*, October, 1959, p 74).

Still much in the research stage but taking on increasing significance are more efficient methods of making electric power. Ten leading power companies joined with the AVCO Corp. in a long-term project to develop a new power generation system based on magnetohydrodynamics (MHD). Aim of the new system is to eliminate the turbine-generator in power-generation cycles.

Prospects for use of the high-temperature fuel cell in generating primary central-station power are dim for the next 5 to 10 yr (*Coal Age*, December, 1959, p 74). "On the basis of potential efficiency advantages alone, however, its long-range prospects for replacing or supplementing conventional or nuclear power sources cannot be ruled out."

STEEL: Due for Major Rebound

Consumption of coal by coke plants and steel and rolling mills hit about 89 million tons in 1959. This topped the 1958 tally by some 5 million tons but missed the predicted growth mark by 18 million tons.

Retarded growth of coal use in steelmaking could be accounted for by the severe 4-mo steel strike which brought ingot output down from a projected level of 110 to an estimated 92 million tons. Barring further strikes in the current year, analysts are forecasting a rebound to record ingot output of 130 million tons. At this level, coke plants and steel mills should consume an estimated 125 million tons of bituminous—a new peak in coal tonnage.

As steel gears up for higher production in the decade ahead, the flurry of excitement during the past 5 yr over direct reduction seems to have cooled off. A *Coal Age* feature (March, 1959, p 66) summed up the situation as follows:

"Technical and economic developments suggest a slow changeover to direct reduction processes. Even this, however, is not a certainty. Thus, most steel companies are simultaneously (1) pursuing greater economies in conventional coke-oven blast-furnace techniques and (2) conducting continuing studies of direct reduction . . .

"In the immediate future, coal producers have little to fear from direct reduction as long as they can deliver a high-quality low-cost product. But, long-range, coal must swing with new trends in steelmaking. The potential plum: A market of 170 to 185 million tons of coal and coal-equivalent by 1975."

Firming up continuing emphasis on conventional steelmaking practice were, for example, the following developments:

1. The Jones & Laughlin Corp. awarded engineering contracts to Arthur G. McKee for building at its Cleveland Works the largest blast-furnace ever built in the steel industry (*Coal Age*, October, 1959, p 66).

2. Bethlehem Steel Co. announced it would add 76 coke ovens (500,000 tons of annual coke-making capacity) to its Lackawanna plant because of increasing needs for blast-furnace fuel (*Coal Age*, January, 1960, p 28).

Another noteworthy item suggests that a so-called "standby" coke-making facility may be staging a modest comeback. At Stonega Coke & Coal Co.'s Pine Branch Colliery, Big Stone Gap, Va., special handling equipment is capable of charging and pushing beehive coke ovens at a rate of one every 3.6 min. The equipment, including two charging larrys, a leveling machine and mobile conveyor, services a new, completely mechanized, 180-oven battery designed to produce some 650 tons of very low-ash, low-sulphur metallurgical coke daily.

INDUSTRIAL: Down 12%; Huge Market Study Underway

Coal burn in the industrial market dropped nearly 12% from 94 million tons in 1958 to an estimated 83 million last year. In 1960, consumption may dip again to an estimated 80 million tons, though it could, instead, show a rise. As defined here, this market includes "other manufacturing industries" (about 87% of the total), cement mills (10%), railroad use (2.5%) and bunker fuel (0.5%). Major factor in the decline is the "other manufacturing industries" group, where tonnage has fallen from a 1947-49 annual average of 110 to last year's estimated 72 million tons. Behind the drop: Continuing losses to gas and oil and a strong tendency for many companies to scramble amongst each other for shares of the available market, instead of fighting to recover or gain new business from competitive fuels.

To reverse this trend and capitalize on prime opportunities for tonnage growth, BCI this year will lead a drive for expanding market research and promotion not only in the industrial but also in the commercial and institutional market (*Coal Age*, November, 1959, p 70). The drive will center on getting full industry cooperation in completing a huge market survey already underway. When completed, the survey will provide one of the most detailed, comprehensive breakdowns of sales potentials in a single market ever developed by any industry.

Other proposals made in 1959 to strengthen coal's position in the industrial market include:

1. A national program to encourage and guide formation of regionally-financed and operated coal-equipment sales and service agencies (*Coal Age*, August, 1959, p 68).

2. An industry program to promote BCI's plan for leasing coal-burning equipment as a method of overcoming the long-standing problem of lower costs for oil and gas equipment.

RETAIL: Down 8 Million But Electric Heat Grows

In 1959, contrary to the predicted leveling-off trend, retail deliveries were down from 36 to about 28 million tons. More losses to gas and oil are blamed with another drop to 25 million tons forecast for the current year.

Last January *Coal Age* (p 70) drew attention to new growth patterns for coal in space heating. "Electric heat," the 10-p feature stated, "could be the coal industry's best hope for recapturing big losses in retail sales during the past 15 yr, and for preventing further conversions to gas and oil where cost advantages alone are not enough to sell direct use of coal with modern coal-burning equipment."

Late in 1959, there was early proof of growth potentials for coal-fired electric heat. At the November meet-

ing of the Southern Coal Producers' Association, Thomas R. Jordan, *Electrical World*, a McGraw-Hill publication, reported power plants consumed an estimated 6.8 million tons of coal to heat some 621,000 residential, commercial and industrial buildings in 1959. This year, Mr. Jordan said, the coal burn for electric heating could rise to 8 million tons.

EXPORT: High Stocks, Oil & Gas Cut Volume

A look at the export market shows:

1. Continuing heavy stocks of coal and tougher competition from oil and gas in big European markets, cutting sharply into overseas shipments.

2. Deliveries to Canada holding firm.

The tonnage box-score is as follows:

	Millions of Tons		
	Est. 1960	Est. 1959	1958
Overseas	20	25	38
Canada	12	13	12
Total	32	38	50

Highlighting the competitive picture, huge oil and gas deposits are now poised for marketing from the Sahara Desert to African points, France and other European countries. Last December, French authorities were scheduled to start operating a 410-mi 24-in oil pipeline from the desert producing area to the Algerian seaport of Bougie on the Mediterranean. Plans call for annual volume shipments as follows (*Coal Age*, October, 1959, p 30):

	Oil, Millions of Tons	Coal Equivalent, Millions of Tons
1960	12	18
1965	50	75
1970	100	150

"These enormous quantities must be viewed against the background of Europe's total consumption of petroleum derivatives in 1957—55 million tons . . .

"With Sahara oil will come gas estimated at 30 million tons coal equivalent by 1965, and 60 million tons by 1975. . . . And various sources say there is little doubt the French would bring pressure upon the ECSC to limit American coal exports to Europe if the marketing of Sahara gas were at stake."

Coal Around

HOW IS coal faring in other countries —production, demand, employment, etc? Capsule reports by McGraw-Hill *World News* correspondents highlight conditions as follows:*

Canada—Output this year about 10 million tons, compared to 9.5 in '59 and 11.7 in '58. Government transport subsidies up last year but still regarded insufficient to offset tougher competition from oil and gas. Imports in '59, mostly from U. S., were 13.5 million tons and will be about same this year. Recent sales of coking coal to Japan bolstering exports which may total 400,000 tons in '60.

Great Britain—Record stocks total 40 million tons as domestic and export demand sags. Production in '59 hit about 229 million tons, down from 237 in '58; plans call for more cutbacks to 227. National Coal Board hoping vigorous sales drive will hike exports to 11.1 million tons by '65; volume last year was 5.3, down from 9.7 in '57. Plans call for major cuts in labor force.

West Germany—'59 production (without Saar) put at 138 million tons hard coal, down from 146 in '58 and postwar high of 147 in '56. Goal in 60's is to stabilize annual output at 132 million tons, with added 16.5 from recently incorporated Saar. Pithead stocks leveling below 18.7 million tons. Since '58, labor force cut 14% and productivity up 19%. Duty-free import quotas remain same: total, 5.6 million tons, with U. S. allotment 4.8.

Belgium—In throes of rebuilding coal economy disrupted severely during the past 3 yr by a compound of factors including overproduction, excessive imports, high prices, government subsidies and labor problems. New factor is cheap oil and gas coming into Europe from the Sahara. Coal output fell to 24.6 million tons in '59 from 29.7 in '58 and a postwar peak of 33. Pithead stocks at 8.5 million tons grew only slightly in '59, mainly due to 75-day closing 30% collieries which would have produced 6.3 million tons. Must freeze existing stockpile and cut capacity from estimated 33 to 22 million tons by '63. In '60, imports from ECSC countries to hit peak 3.2 million tons; from U. S. down sharply to 440,000 tons plus 550,000 coking on commission for Luxembourg. Bituminous prices being forced down; profits outlook depressed.

Netherlands—Production in '58, '59 and '60 figured about the same at 13 million tons. Stocks estimated around 1 million tons. Imports dropped some 550,000 tons in '59; exports were up about 400,000 tons.

France—Output at 66 million tons about the same in '59 as in '58. Last year total imports, mostly from ECSC countries, were 17.9 million tons, with U. S. purchases down from 3 million tons in '58 to 890,000. From '60 to '65, production and imports expected to stabilize at '59 levels, if annual rate of economic expansion continues at 3 to 4%. Oil and natural gas from Sahara (see Export) may require closing marginal mines.

Spain—Growing competition from petroleum fuels shatters hopes of raising total coal output in '60; volume in '59 was about 17.2 million tons, down from 18 8 in '58. Stocks high at 5 million tons. Imports dropping sharply. Government measures keep employment stable, but working time due for cuts.

Poland—Hard coal production in '59 put at 108.9 million tons, 2.4 over planned; '58 tally was 104.2. '60 plans call for upping output to 113 million

* All tonnage data in short tons of 2,000 lb. The term "hard coal," where used, usually means bituminous, but, in a few cases, may include small amounts of anthracite.

Pithead stocks of coal in ECSC countries were put at 32.6 million tons in September, 1959, compared to 22.5 million tons in the same month of the previous year. In spite of the climb during the 12-mo period, official reports indicated that stops in West Germany and other ECSC countries apparently halted their upward trend in September, 1959, and were now declining.

Along with the apparent decline in inventories, there is another encouraging note, especially for producers shipping metallurgical coals. Latest reports from the United Nations Economic Commission for Europe show that steel and other European industries had recovered in 1959 from 1958 slumps and were now moving ahead at normal growth rates.

Problems; Progress

MANAGEMENT: Cause For Pride and Concern

Going into the sixties, the industry could be justly proud of great prog-

the World . . .

tons; will require boosting productivity per miner shift by 165 lb.

U. S. S. R.—Production in '59 should reach 555 million tons, about 3% more than '58. Planned output for '65 is some 662 million tons. By end of 7-yr plan, coal's share of total fuel production expected to fall from 57 to 43% as government increases oil-gas share under crash expansion program. Russian planners say coal too expensive; industry ordered to modernize equipment, stress coking coal, improve overall quality.

Czechoslovakia—Based on first 9 mo, hard coal output hit about same mark in '59 as in '58—28 million tons; brown coal was off slightly from 59.7 to 56.6 million tons. Goal for '65: 39 hard and 80.3 million tons brown coal. Exporting about 1 million tons brown coal annually to West Germany.

Bulgaria—'59 output, slightly over planned, figured at 16.8 million tons hard and brown, mostly brown. Production high but many press complaints about quality.

Austria—Consumption fell from 8.6 in '58 to 7.7 million tons hard-coal equivalent; output (mostly sub-bituminous and lignite) from 6.5 to 6.1; imports (mostly bituminous) from 4.2 to 3.5. Noted is distinct shift from U. S. and Polish toward Soviet and Czech coals. Stockpiles are high and will grow unless production is slowed. Government may close some marginal mines.

India—Based on 1st 9 mo, production in '59 was running at annual rate of 51.5 million tons, compared to '58 final of 49.8. Second Five-Year Plan target for year-end '60 was 66 million tons. Prospects of reaching this uncertain as annual production increases have slowed due to reorganization government-owned collieries which should have turned out added 13 million tons. Steel mill needs rising sharply.

China—Last year nearly reached revised target of 335 million tons. Most major mines now mechanized, and use combines which cut and transport coal to surface. Advanced hydraulic coal mining techniques adopted in 178 working areas. Miner lifted to honored social status; gets four times '49 wages and free medical service.

Japan—'59 production put at 48 million tons with 53 in prospect this year. Demand is much improved over '58 and stocks, moving down fast, should reach normal 2-million-ton level by March. Labor force is being cut sharply. Government subsidies planned to meet oil competition. Between April and October, '59, imports were 3.2 million tons, about one-third from U. S.

Australia—Production of black [or hard] coal, at some 20 million tons, was about the same in '59 as in '58; brown coal was up from 11.6 to 13 million tons with another jump due in '60. Intensified export drive seeks new markets in Asia and South America. Employment is dropping and pressure increases for more miners' benefits, including shorter hours. Several employers worried about ability to absorb wage and other cost increases. 1960 will see first serious attempt to set up export trade in coal-mining machinery, most built under license from U. S. and U. K. makers.

Union of South Africa—Output dropped from 40.9 in '58 to 40.2 million tons last year. With saturated market, larger mines are cutting back and several small producers are closing. Despite low pithead price of $1.40 to $1.80 per ton, exports are moving slow at only 350,000 tons annually. Producers are installing more efficient washing processes but overall intensive mechanization viewed cautiously because of huge low-paid Negro labor reserve available.

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ress during the past 10 yr. Its product was almost unique in the American economy for having resisted the general upward spiral in prices. At year's end, the mine price of coal stood at an estimated $4.76, compared with $4.84 in 1950. The price feat was accomplished while the average daily wage (excluding fringe benefits) was rising a total of $10.20 during the 10-yr period. It was made possible by rapid advance in mechanization, a general boost in productivity from 6.8 to 12 tpd and aggressive cost-cutting programs, which included gains in safety, maintenance and mine engineering. It was accompanied by continuing improvement in the art of preparing quality products from an ever-widening range of coals.

With all this, however, coal management had cause for considerable concern. Progress in past decades has been based primarily on great gains in mechanization and productivity. To realize the promise of the future, industry leaders found pressing need for charting a new or revised course. Coal must not only maintain the pace of past production gains; it must match and integrate them with equivalent gains in market development and merchandising techniques.

Management's response to the challenge included formation of the National Coal Policy Conference last February (*Coal Age*, April, 1959, p 28) and reorganization of the National Coal Association last June (*Coal Age*, July, 1959, p 120). In both cases, the emphasis was on setting up or improving on machinery for solidifying and expediting industry growth.

Greater strength on the industry-wide level was not the only area of concern. A *Coal Age* feature (June 1959, p 74) showed how individual companies should modernize their management practices in planning, reorganizing and operating for maximum profits-return today and tomorrow. In adopting these practices, the more progressive companies are finding the means of solving such major problems as:

"1. How to keep wage boosts from outstripping increases in productivity.

"2. How to gain maximum profits return from higher investments in labor and equipment.

"3. How to stay ahead of competition, which is still tough and getting tougher.

"4. How to meet the increasing demand for more skilled managerial talent.

"5. How to accumulate capital funds for equipment buying and capacity expansion."

RESEARCH: Cooperative Programs Advance

At its annual meeting last April, Bituminous Coal Research underscored one key facet of the total challenge to management. Featured speakers not only expressed doubt about coal's ability to commercialize results to date, but also concern over its willingness to meet the demands of modern technology (*Coal Age*, June, 1959, p 154).

On the more encouraging side, the April meeting stressed a trend toward cooperative programs with industry-affiliated groups. Such programs now include studies (1) with electric utilities and the Commonwealth of Pennsylvania on air-pollution control; (2) with Hercules Powder Co. on improved mining equipment; (3) with the AEC on potential uses of

Thought for the '60s

THESE ARE TIMES when dedicated men in the coal industry are, or should be, sobered by their "vanishing markets," and when there is still time for critical decisions which could result in holding remaining markets and also in developing new ones.

Competition is not new to this industry nor has loss of markets gone unnoticed. The railroad and home markets were the first. But while losing these markets the industry has been favored by the increased use of coal by its utilities, metallurgical and industrial partners. In part, the coal industry can take credit for holding these markets by its determined efforts to cut cost and enhance quality. But if these three markets had not required more coal, where would the industry be today? And what is the industry doing to protect itself in these markets, and what decisions are being made that will lead to the expansion and development of other markets?

The first question can be answered simply and proudly: It has successfully cut production costs and enhanced the quality of coal. However, satisfaction with past accomplishments is not a measure of the greatness of an industry nor does it give an industry the right to be complacent about its future. What about the second question? Naturally, the answer to the first has some bearing on the second and it can be expected that the industry will continue its successful campaign to keep costs down and enhance quality. But in considering the second question further, one fact becomes clear:

The coal industry has not established itself as a leader in research. There are few industries that can survive today without a well planned research program.

There have been a number of industries, unrelated to coal, that have found its by-products very useful. This has helped the coal industry, but coal had very little to do with these findings. The development of synthetic liquid fuel and gas, which will consume large quantities of coal in the future is not, so far at least, a direct product of the industry's research efforts.

If these developments are the results of research primarily outside the industry, what would the potential uses of coal be today if the coal industry had established an adequate research program of its own years ago? This emphasis on research is not new but it remains, along with cost-reduction and quality-enhancement, the best move the coal industry can make at this time to protect present markets and develop new ones. Markets cannot be gained by asking government to award them to coal. The industry can only ask for protection against unfair competition.

Neither should coal rely on others—the federal government, for example—for jobs it should be doing itself. Markets "are rightfully and economically coal's province" only when the coal industry can offer consumers more benefits than its competitors. Coal has prided itself on being independent and not being subsidized. If it is to preserve this freedom it must reach decisions and take action accordingly.

Research is expensive but its products are profit-makers and serve as a catalyst in making an industry economically sound. Financing a research program naturally brings up problems. But coal can—and should—develop its own plan and provide itself with the type of research program that will produce profit-makers and economic catalysts. Employees as well as management and owners have a stake in the idea, because more business means more jobs at high pay. A big job for all in the '60s is to develop the proper support for a real research job—not a few hundred thousand but rather several million a year. With financing on that scale coal will be prepared—with its own program under its own control—to cash in on existing opportunities in the '60s, and create new ones.

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radioisotopes in the mining, storage, transport and use of coal; and (4) with USBM on possible use of the coal-fired gas turbine for power generation in stationary plants.

BCR last year also reported substantial progress (1) in studying how the plasticity of bituminous coals affects the design of combustion equipment, and (2) in field-testing a device for the continuous measurement and recording of moisture in coal as it passes over a conveyor.

Field testing continues on BCR-developed equipment, including the Coal-Pak, Coal-O-Matic, Fire Jet Stoker and Easy-Flo bin device. In connection with all, technical problems of major concern have been overcome.

Outstanding among other research activities are the following:

1. Consolidation Coal Co. signed a long-term agreement with Standard Oil of Ohio to study methods of making hydrocarbon liquid fuels from coal (*Coal Age*, February, 1959, p 28).

2. Island Creek Coal Co. finished its new research center at Holden, W. Va., with initial projects focusing on carbonization studies (*Coal Age*, March, 1959, p 28).

3. Curtiss-Wright Corp. signed a $200,000 contract with the Kentucky State Highway Dept. for an extensive research program on use of coal as a binder material in road-building. (*Coal Age*, August 1959, p 28).

4. United States Fuel Co. announced at the end of the year a new process for producing coke pellets for reducing elemental phosphorus in electric furnaces or as blast-furnace feed. Coal fines are first pelletized, with water and a binder. The pellets are then reacted with natural gas in a heated chamber. Volatile matter, based on Utah coals from U.S. Fuel mines, is cut to less than 1%. Next step for U. S. Fuel: a $250,000 50-tpd unit to provide enough coke for test runs in phosphorus and blast furnaces.

5. Food Machinery & Chemical Corp. announced the start of construction in January of a $3½ million plant at Kemmerer to convert native coal to coke. The two-stage process involves preheating to produce a semicoke, followed by briquetting and final heating to produce coke. FMC, among others, is in need of carbon for phosphate furnaces. The process, it was noted, can supply coke for blast furnaces. No by-products are produced.

TRANSPORT: Other Methods Vie with Rails

Alternative methods of transport continue to put further pressures on rail haulage.

A *Coal Age* feature (April, 1959, p 78) pointed to these signs of increasing dependence on river movement of coal:

"1. Persistent growth in barge movement of bituminous as a percentage of total production.

"2. Unchecked momentum in the migration of industrial plants to river areas where ample supplies of water and low-cost transport are available.

"3. Aggressive modernization of inland waterway navigation systems to anticipate heavier traffic loads.

"4. Continuing improvement in the design of tow, barge and dock equipment to provide more efficient haulage and handling."

An interesting case of more emphasis on water movement of coal took concrete shape in a deal between Tampa Electric Co., Peabody Coal Co. and Virginia-Carolina Chemical Co. The three companies formed two shipping firms which will use a converted tanker and 64 barges to transport coal to the utility's Gannon Station, returning from Tampa with phosphate products for ports on the Gulf Coast, and on the Mississippi, Ohio and Illinois river systems (*Coal Age*, December, 1959, p 28).

Proposed coal-pipeline projects again made news. One project under study by Consolidation Coal Co. and four major eastern utilities would link coal-producing fields in West Virginia with steam generating plants in N. Y., N. J. and eastern Pennsylvania (*Coal Age*, October, 1959, p 31).

Another project was reported under discussion with utilities by the newly formed Youngstown Coal Pipelines Co. This project would involve moving steam, and possibly metallurgical, coal from the pipeline's Ohio River terminus at East Liverpool, Ohio, to the Great Lakes port of Ashtabula, Ohio (*Coal Age*, December, 1959, p 28).

Reacting to added pressures from alternate methods of transport, railroads are stepping up their drive to recover lost business. As put by the "Coal Commentator" (*Coal Age*, December, 1959, p 11):

" 'Don't count us out of the coal-hauling picture yet.' That is more and more the railroad-rallying cry . . . The greater rate-making freedom now in the offing is a major factor in greater railroad-executive confidence in their coal-hauling picture, coupled with their growing disposition to use this power and other weapons at their command to get and retain business, particularly coal business."

One outstanding example of greater rate-making freedom materialized early in the year with ICC approval of a 50c per-ton cut in freight rates to volume-tonnage eastern-utility customers (*Coal Age*, April, 1959, p 72).

LABOR: New Contract Dominates

Effects of the new bituminous wage contract, signed in December, 1958, dominated the labor year in 1959. Pay hikes, totaling $2 on April 1, 1959, sent the daily basic wage rate up to $24.25, thus strengthening the coal miner's position as the highest paid of all U. S. workers in basic industries. They were not accompanied by price boosts, however. In fact, the average mine price of coal per ton fell from $4.86 in 1958 to an estimated $4.75 last year (USBM estimates: $4.86). Key factor in the drop was a 25c per-ton cut in the price of utility coal in April, 1959. Later, similar cuts were extended to other volume-tonnage customers.

Early in the year, Harlan County (Ky.) operators, refusing to accept terms of the new UMWA contract, closed 26 mines, leaving about 3,100 of the county's 5,000 workers idle (*Coal Age*, April, p 30). By year's end, according to latest reports, much employment had been restored. Some operators reopened on the new contract basis. Others, refusing to sign, resumed operations by taking men back who were willing to work at independent wage levels.

When the Labor-Management Reporting and Disclosure Act of 1959 was passed, administrators of the new contract ran smack up against another problem. Certain provisions, together with amendments to the National Labor Relations Act, apparently negate the contract's protective-wage clause, under which commercial operators had agreed not to buy or handle nonunion coal. Until these provisions could be "administratively and judiciously interpreted and clarified," the Joint Industry Contract Committee suspended enforcement of the clause.

In the wake of the prolonged steel strike, layoffs at some Pennsylvania and West Virginia coal mines supplying steel mills were assuming serious proportions until the Taft-Hartley back-to-work order in November reversed the trend. Although the layoffs were largely temporary, the problem of unemployment in depressed coal-mining areas was by no means solved. A newly created Senate study group will give the problem close attention in 1960.

LEGISLATION: Building A Framework for Gains

When Congress adjourned last September numerous measures had been passed or proposed which built a framework for potential gains in 1960 and subsequent years.

In public power policy, H. R. 3460, signed into law Aug. 6, authorized TVA to issue up to $750 million worth of revenue bonds to finance expansion of its power-generating and transmission facilities. The gain here: Use of the funds was restricted to a prescribed service area.

Resolutions were passed which (1) created a Senate committee to study unemployment problems in depressed areas; (2) gave consent of Congress to an interstate compact for conserving oil and gas; (3) called for legislative changes necessary to maintain a sound and stable domestic mining and minerals industry; and (4) proposed establishment of a 16-man joint Congressional committee on national fuels policy.

In the same framework for potential gain were bills awaiting further action which would (1) amend the Federal Coal Mine Safety Act to eliminate the present exemption on mines employing less than 15 men, and (2) increase the depletion allowance for coal and lignite to 27½%.

At least temporarily, coal suffered a major loss when President Eisenhower vetoed H. R. 6596 which would have created an independent coal research and development commission. To overcome presidential objections, informed sources look for a new bill which will put funds involved under USBM jurisdiction.

Also of interest on the legislative scene was passage of the Labor-Management Reporting and Disclosure Act of 1959 (see "Labor").

Carry-over measures which bear close watching by coal aim at strengthening federal authority on air and water pollution control, alleviating car-supply shortages, eliminating "good faith" defense in price discrimination, and at requiring 60-day premerger notification.

THE NEWEST WHEEL EXCAVATOR, unveiled in 1959, removes overburden at a rate of 3,500 tph and stacks it 420 ft from point of pickup. The machine weighs 2,100 tons and features a stacker belt speed of 1,000 fpm.

Mining, Stripping, Preparation in 1959

Highlights of the Year:

Increased tempo in equipment development

Top-notch engineering to head off problems

Ultramodern plant and property designs

THE ACCENT in 1959 was on methods planning, equipment refining and in-the-mine research in pursuit of lower costs, especially in providing services to the production operation. This was the tone in deep mining, stripping and preparation. In deep mining, particularly, it was felt that the all-around improvement of services offered the greater opportunity for substantial cost reductions since possible gains from further labor economy have about run out their string, for now. Fullest improvement of services calls for tighter concentration of production operations, the old standby which leads to lower costs for ventilation, power distribution, transportation and the like.

Deep Mining

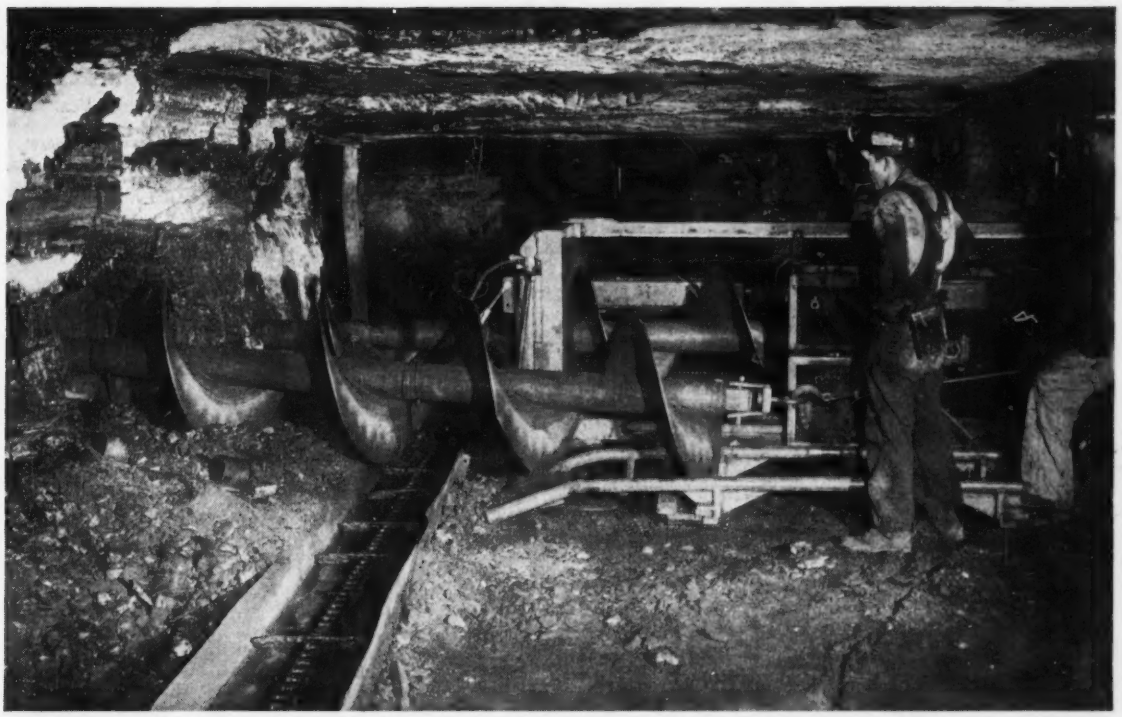
EXAMPLES of these 1959 orders-of-business in deep mining are evident in continuous and conventional mining systems, in high coal and low coal, and at big mines and small. The trend, however, was toward further consolidation of companies leading to the development of high-capacity properties, several of which were unveiled in 1959.

As the year moved along equipment manufacturers rounded out their lines of AC-powered deep-mining machines and auxiliary equipment for most mining systems. Operators reported substantial savings all along the line in AC over DC.

Continuous Mining

The scene in continuous mining was dominated by the introduction of a number of new machines, particularly machines of lower height. Included among these were a boring-type miner for seams 4½ ft thick, a unit featuring vertically-mounted cutting drums on gathering arms for seams as low as 30 in, and a machine for seams as low as 32 in which employs an auger-like drum that sweeps back and forth across the face after sumping 30 in.

In a number of instances, boring-type machines were chosen primarily for the additional roof stability that generally prevails in bored openings. However, the boring units practically fill the immediate face area, making it difficult to sweep the face with a ventilating current of air. For this reason one of the most active in-the-mine research programs during the year centered on the development of auxiliary face-ventilation equipment and systems. Late in the year



UNDERGROUND AUGER makes possible the recovery of otherwise unmineable coal. The auger consists of two separate units, a power unit and the augering unit. Productivity is high in thin coal.

extensive tests were conducted underground in the use of double-warp brattice cloth which, when properly installed, provides a competent duct for ventilating air.

Conventional Mining

New designs for conventional mining included loading machines rated at up to 15 tpm, new coal drills which require only one man to operate two drill booms.

A practicable system for multiple breaking with compressed air was brought to full realization in 1959. As explained in the January, 1960, issue of *Coal Age* (p 78), a series of four holes may be broken in one operation of the blow-down valve by the shotfirer. Heart of the system is a number of sequence valves on a self-propelled truck which also carries the tubes from place to place. The tubes for use with the new system are lighter in weight and are equipped with automatic discharge heads, thus eliminating the need for changing shear strips.

Miniature units were placed on the market to bring the benefits of mechanized production to smaller companies operating in thin seams. The forerunner is a rubber-tired cutting machine, with shuttle cars and probably loading machines under consideration.

Special units for unusual conditions also were highlights of the year. Among these were 15-ton shuttle cars, 15-tpm loading machines and self-propelled roof-bolting "platforms," all for operations in thick coal (*Coal Age*, July, 1959, p 72).

Conveyor Mining

Operators of conveyor mines were served through the development of a complete system employing a continuous miner coupled by bridge conveyors to a mobile chain conveyor, the latter discharging onto an extensible belt conveyor. The system provides for the driving of a multiple-heading panel, although the main chain and belt conveyors are permanently installed in the center heading. Belt extensions are made at 60-ft intervals in approximately 15 min with specially-designed mechanical assistance, and each extension permits mining of 1,500 tons in 48-in coal with no transportation delays. A description of an actual underground application of the system is scheduled for publication in an early issue of *Coal Age*.

Year-end reports told of a new extensible mine conveyor that can operate for a week or more without being moved. It is comprised of a belt which rides on idlers mounted on sled-like skids at 5-ft intervals. The skids are aligned by lateral wire ropes. Electro-hydraulic crawler-mounted tractors are provided at each end to provide constant tension. A traveling tripper permits variation in the distance from loading point to discharge point along the conveyor. A more complete description of this appears in the Equipment Developments department of this issue.

Modified Systems

Mining systems were modified at a number of properties to achieve higher overall efficiency. At one mine (*Coal Age*, September, 1959, p 100), the coal from three conventional units collects at one loading point, thus simplifying haulage and other services. Two of the units work opposite

sides of a room panel and the third develops entries. The panel belt discharges to the entry belt which feeds a cross belt to the loading point. The entry belt and track are installed in adjacent parallel headings. The entire production is concentrated in these three units.

At one of the industry's big new mines engineers and operating officials have designed main entries with variable center distances between headings. This practice increases the sizes of pillars along the center of the entry to provide an extra measure of protection against squeezes and other problems of overburden pressure. A diagram of the layout appears on p 81 of the December, 1959, issue, and a description on p 83.

Other developments contributed to faster handling of coal with the utmost economy in labor. Special feeders were installed at a number of mines to meter the full discharge rate of a shuttle car into the lower acceptance rates of mine cars or belt conveyors, resulting in a substantial reduction in shuttle-car delays without necessitating changes in intermediate or main transportation units. One type employed converging chains and another inflatable sides to meter the flow of coal.

Kin to these feeders were the new automatic carloading systems which came into increasing use in 1959. One of these is a full-electric unit which provides the monitoring for a between-the-rails, motorized carspotter (*Coal Age*, April, 1959, p 96.) Others featured simplified hydraulic controls for positive operation (April, p 158).

Thin or Pitching Seams

Successful underground augering offered a new lease on life for operators faced with difficult natural conditions. A Tennessee mine (*Coal Age*, November, 1959, p 76) employs a 34-in auger to recover coal that could not otherwise be profitably mined. The equipment consists of two units, power and augering. Projected drilling depth is 100 ft, a distance that can be drilled in about 1 hr for a yield of 23 tons. The two-man crew has drilled a 100-ft hole and moved to the next setup in 53 min.

Reports tell of the use in anthracite of a similar 2-unit auger to raise ven-

New Bituminous Preparation Facilities

Coal Company	Plant Location	Capacity, TPH	Preparation Equipment
Allison Engineering Co.	Allison Park, Pa.	175	Jeffrey[1]
Amherst Coal Co.	Fanco, W. Va.	...	Kanawha[2]
		...	Combustion Engrg[3]
	Amherstdale, W. Va.	...	Heyl & Patterson[10]
	Lundale, W. Va.	30	Denver[42]
Armco Steel Corp.	Montcoal, W. Va. (12)	36	Kanawha[2] Western Machinery[4] Bird[5]
Beckley Transportation Co.	Richwood, W. Va.	125	Link-Belt[6]
Benjamin Coal Co.	LaJose, Pa.	150	Roller[7]
Bethlehem Mines Corp.	Century, W. Va. (2)	82	Roberts & Schaefer[9, 9] Bird[5]
Bolt Mining Co.	Bolt, W. Va.	200	Daniels[9]
Boone County Coal Corp.	Moncle, W. Va.	...	Kanawha[10]
Buckeye Coal Co.	Nemacolin, Pa.	225	Nelson L. Davis[11]
Buffalo Coal Co.	Bayard, W. Va.	200	Irvin-McKelvey
Carbon Fuel Co.	Carbon, W. Va.	...	Kanawha[2]
		80	Heyl & Patterson[12]
Carpentertown Coal & Coke Co.	Kittanning, Pa.	180	Heyl & Patterson[63]
Cherry River Coal & Coke Co.	Webster Springs, W. Va.	65	Roberts & Schaefer[12]
Clinchfield Coal Corp.	Clinchfield, Va.	150	Link-Belt[3]
	Clinchfield, Va. (2)	160	Heyl & Patterson[54]
		...	Western Machinery[4]
			Fairmont[2]
	Dola, W. Va.	150	Heyl & Patterson[31]
			Dorr-Oliver[14]
Colorado Fuel & Iron Corp.	Pueblo, Colo.	30	Denver[42]
Crozer Coal & Land Co.	Dott, W. Va.	...	Kanawha[2]
		80	Heyl & Patterson[12]
Dawson Collieries, Inc.	Dawson Springs, Ky.	80	Heyl & Patterson[12]
DeBardeleben Coal Co.	Sipsey, Ala.	400	McNally-Pittsburg[15]
Eastern Gas & Fuel Associates	Barrett, W. Va.	350	Kanawha[16, 2]
	Barrett, W. Va. (12)	40	Western Machinery[4]
	Colver, Pa.	50	Roberts & Schaefer[17, 9]
	Colver, Pa.	...	Cent. & Mach. Ind.[18]
Elk Creek Coal Co.	Emmett, W. Va.	...	Heyl & Patterson[31]
Elkfoot Coal Co.	Grundy, Va.	150	Daniels[9]
Elk River Coal & Lumber Co.	Widen, W. Va.	700	Industrial Engr.[19]
Enos Coal Mining Co.	Enosville, Ind.	430	Link-Belt[20]
Feds Creek Coal Co.	Biggs, Ky.	350	Kanawha
Green Coal Co.	Panther, Ky.	...	Heyl & Patterson[31]
Guardian Coal Co.	Gilmore, W. Va.	60	Industrial Engr.[2] McNally-Pittsburg[21]
Hi-Hat Elkhorn Mining Co.	Hi-Hat, Ky.	30	Kanawha[22]
Island Creek Coal Co.	Bartley, W. Va. (2)	100	Roberts & Schaefer[9]
	Bartley, W. Va. (2)	...	Cent. & Mach. Ind.[18]
	Emmett, W. Va.	16	Kanawha[2] Dorr-Oliver[23]
	Pine Creek, W. Va.	80	Heyl & Patterson[12]
	Holden, W. Va.	...	Dorr-Oliver[24] Heyl & Patterson[31]
Jewell Eagle Coal Co.	Jewell Ridge, Ky.	...	Heyl & Patterson[31]
Jewell Ridge Coal Co.	Tilford, Ky.	100	Dorr-Oliver[25]
		...	Ducon[26]
	Jewell Ridge, Ky.	150	Deister Concentrator[27]
Kentucky Ridge Coal Co.	Crockett, Ky.	25	Deister Concentrator[27]
Kingwood Mining Co.	Kingwood, W. Va.	150	Irvin-McKelvey
Lake Superior Coal Co.	Superior, W. Va.	350	Kanawha[28]
Lester Smokeless Coal Co.	Beckley, W. Va.	50	Roller[7]
Mather Collieries, Inc.	Mather, Pa.	...	Heyl & Patterson[31]
Mathies Coal Co.	Courtney, Pa.	216	Deister Concentrator[27]
Margaret Ann Coal Co.	Conaway, Va.	250	Daniels[9]
Mountaineer Coal Co.	Fairview, W. Va.	...	Fairmont[29]
Nassau Coal Co.	Pageton, W. Va.	10	Kanawha[30]
	Pageton, W. Va. (2)	10	Heyl & Patterson[31, 60]
Pennsylvania Coal & Coke Corp.	Heshbon, Pa.	50	Roberts & Schaefer[33]
		50	Roller[7]
Pine Oaks Coal Co.	Hurley, Ky.	100	Prins[32]
Pine Township Coal Co.	Heilwood, Pa.	...	Heyl & Patterson[41]
Pittsburgh Coal Co.	Hutchinson, Pa.	...	Fairmont[34]
	Hills, Pa.	...	Fairmont[35]
	Champion, Pa.	100	Fairmont[36]
	Itmann, W. Va.	550	Fairmont[37]
	Itmann, W. Va. (2)	...	Heyl & Patterson[31]
	Itmann, W. Va. (2)	150	Dorr-Oliver[38] Fairmont[39]
Pocahontas Fuel Co.	McComas, W. Va.	...	Heyl & Patterson[31]
	Bossevain, W. Va.	...	Heyl & Patterson[31]
	Crane Creek, W. Va.	10	Denver[42]
Ponfeigh Smokeless Coal Co.	Berlin, Pa.	150	Jeffrey[38]
Red Bird Mining Co.	Iaeger, W. Va.	75	Jeffrey[1]
Red Parrot Coal Co.	Prenter, W. Va.	400	Kanawha[16]
Robinson-Phillips Coal Co.	Baileysville, W. Va.	75	Jeffrey[1]

Contracted for in 1959*

Coal Company	Plant Location	Capacity, TPH	Preparation Equipment
Republic Steel Corp.	Republic, Ky.	350	Fairmont[10]
	Fredericktown, Pa. (3)	240	Heyl & Patterson[12]
	Sayre, Ala.	...	Heyl & Patterson[31]
Rochester & Pittsburgh Coal Co.	Ernest, Pa. (8)	300	Heyl & Patterson[3, 57]
		100	Deister Concentrator[27, 48]
Rogers County Coal Co.	Chelsea, Okla.	300	McNally-Pittsburg[46]
Russel Fork Coal Co.	Mikegrady, Ky.	...	Kanawha[41]
	Mikegrady, Ky. (15)	47	Heyl & Patterson[31]
Sahara Coal Co.	Harrisburg, Ill.	...	Roberts & Schaefer[2, 18]
		...	Heyl & Patterson[31]
	Harrisburg, Ill. (9)	215	Deister Concentrator[27, 47]
Scott Bros. Coal Co.	Glasgow, Pa.	...	Irvin-McKelvey
Sekora Coal Corp.	Gibsonia, Pa.	70	Jeffrey[1]
Semet-Solvay Div.	Montgomery, W. Va.	...	Heyl & Patterson[59]
Slab Fork Coal Co.	Alpoca, W. Va.	...	Kanawha[3]
	Alpoca, W. Va.	3	Dorr-Oliver[24]
	Alpoca, W. Va.	3	Eimco[42]
	Mary Gaston, W. Va.	...	Kanawha[3]
	Mary Gaston, W. Va. (4)	100	Deister Concentrator[27, 47]
	Slab Fork, W. Va.	100	Deister Concentrator[27, 48]
	Slab Fork, W. Va. (2)	160	Heyl & Patterson[12]
	Slab Fork, W. Va.	...	Dorr-Oliver[24]
	Slab Fork, W. Va.	...	Eimco[42]
	Slab Fork, W. Va.	25	Western Machinery[4]
	Paintsville, Ky.	96	Deister Concentrator[43, 47]
Southeast Coal Co.	Paintsville, Ky.	900	Jeffrey[44]
	Irvine, Ky.	400	Heyl & Patterson[58]
Southern Electric Generating Co.	Parrish, Ala.	750	McNally-Pittsburg[45]
Stonefort Corp.	Wyoming, Ill.	650	Roberts & Schaefer[2]
			McNally-Pittsburg[15]
			Bird[1]
			Robert Holmes[16]
Sugar Grove Coal Co.	Quinwood, W. Va.	75	Jeffrey[10]
Tioga Coal Corp.	Tioga, W. Va.	100	Fairmont[2]
	Tioga, W. Va.	50	Heyl & Patterson[61]
	Tioga, W. Va.	...	Deister Concentrator[27, 47]
United Electric Coal Cos.	Banner, Ill.	260	Roberts & Schaefer[2, 49]
	Banner, Ill.	40	Roberts & Schaefer[32]
	Banner, Ill.	...	Eimco[30]
United Pocahontas Coal Co.	Crumpler, W. Va.	65	Wilmot[51]
		12	Denver[54]
U. S. Steel Corp.	Gary, W. Va.	130	Western Machinery[4]
	New Eagle, Pa.	35	Western Machinery[4]
	New Eagle, Pa.	8	Peterson[52]
	New Eagle, Pa.	75	Deister Concentrator[43]
	Robena, Pa.	15	Denver[53]
	Wellington, Utah	800	Dorr-Oliver[25]
	Wellington, Utah	...	Ducon[26]
Valley Camp Coal Co.	Maidsville, W. Va.	...	Heyl & Patterson[33]
Vansant Coal Co.	Vansant, W. Va.	200	Daniels[9]
Walter H. Duncan, Inc.	Shaw, W. Va.	150	Irvin-McKelvey
Weirton Ice & Coal Supply Co.	Weirton, W. Va. (2)	160	Heyl & Patterson[12]
West Virginia-Kentucky Coal Co.	McAndrews, Ky.	100	Daniels[2]
	McAndrews, Ky.	80	Heyl & Patterson[31]
	McAndrews, Ky.	50	Deister Concentrator[27]
Weyanoke Coal & Coke Co.	Arista, W. Va.	25	Deister Concentrator[27]
Winding Gulf Coals, Inc.	Maben, W. Va.	150	Lively, J. O.[2]
			Fuel Process[58]
Youngstown Mines Corp.	Dehue, W. Va.	250	Nelson L. Davis[11]
	Dehue, W. Va.	100	McNally-Pittsburg[21]
	Dehue, W. Va.	...	Dorr-Oliver[56]

* Includes contracts for installation of new preparation equipment in existing structures. Where more than one equipment item was installed, the number, when known, is shown in the parentheses following the plant address.

1. Unit washery. 2. Prime contractor. 3. Raymond flash-drying plant. 4. Wemco Fagergren flotation cells. 5. Bird Humboldt dryer. 6. Multilouvre dryer. 7. Prefabricated heavy-medium equipment.

8. Dutch State Mines heavy-medium cyclones. 9. Including DMS heavy-medium equipment. 10. Waste-water disposal system. 11. Neldco heavy-medium equipment. 12. Reineveld centrifugal dryers. 13. R&S Super-Airflow. 14. Dorrclones.

15. Including McNally Mogul washer and McNally fine-coal jig. 16. Bin storage, feeding, blending facilities. 17. Including Dutch State Mines heavy-medium cyclones, Super Airflow. 18. CMI centrifugal dryers.

19. Including washing and centrifugal drying equipment. 20. Thermal-drying equipment. 21. McNally fine-coal jig. 22. Kanawha-Belknap calcium chloride washer. 23. Dorr thickener and American filter.

24. Dorr thickener. 25. Dorrco FluoSolids system. 26. Cyclones for Dorrco FluoSolids system. 27. Concenco "77" coal washing tables. 28. Bin storage and auxiliaries and American Air Filter dust-collection units.

29. Includes dust-collecting equipment and alterations in conveying and ash-handling systems. 30. Including ORC jig and H&P cyclones. 31. Heyl & Patterson cyclones. 32. R&S SuperAirflow. 33. Standard Prins washer.

34. Complete shaker screen. 35. Slope-bottom equipment. 36. Fine-coal dryer. 37. Fine-coal plant and water clarification system. 38. Diaphragm-jig equipment. 39. Cleaning plant alterations. 40. Raw-coal screening and loading.

41. Water clarification circuit. 42. Eimco Agidisc filter. 43. SuperDuty Diagonal Deck No. 7 coal-washing tables. 44. Baum-type jig equipment. 45. Including McNally Giant washer. 46. Baughman thermal-drying equipment.

47. Concenco revolving feed distributors. 48. Concenco feed splitters. 49. Dutch State Mines heavy-medium shallow bath. 50. Eimco thickener and Agidisc filter. 51. Wilmot Hydrotator equipment.

52. Platform unit disc filter and all accessories for handling cyclone underflow. 53. H&P Sieve Bends and cyclones. 54. Reineveld dryer and H&P cyclones. 55. Heavy medium equipment. 56. American filter.

57. Washing and drying plant, including heavy media, screens, Reineveld dryers, H&P fluid-bed dryer and H&P cyclones. 58. Fine-coal cleaning and drying plant, including H&P cyclones, H&P distributors and H&P fluid-bed dryer with 408 tph capacity.

59. H&P Sieve Bends. 60. ORC fine coal washer. 61. ORC fine coal washer and H&P cyclones. 62. Preparation plant, including H&P heavy media, screens, Reineveld dryers, Sieve Bends, H&P distributor and wet tables, H&P cyclones and vacuum filter. 63. Denver No. 30 "Sub-A" flotation machines, including a 17-cell unit at Amherst Coal Co.; a 5-cell unit at Robena of U. S. Steel; a 3-cell machine at Crane Creek for Pocahontas Fuel, and two 2-cell units at CF&I to double plant capacity. 64. Including 4-cell Denver No. 30 "Sub-A" flotation machine, 9-ft x 5-disc Denver disc filter, 40-ft Denver spiral-rake thickener and 3x3-in Denver SRL pump.

tilation and loading chutes in pitching seams. The augering unit follows a boring-type continuous miner which develops the gangways.

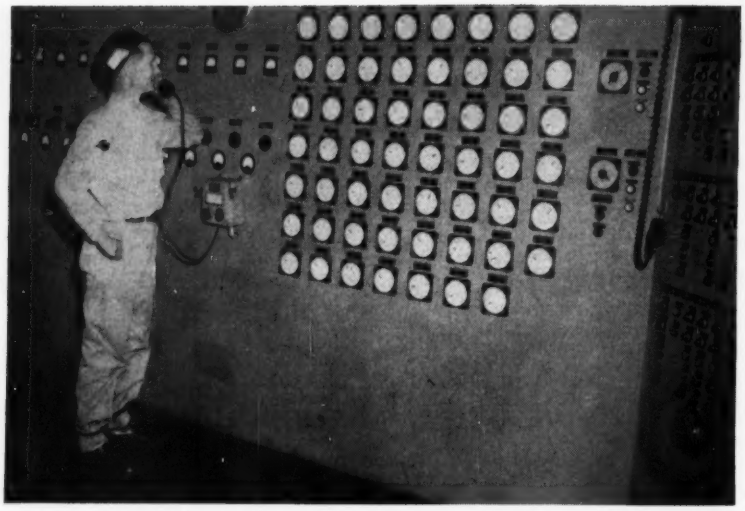
Augers were increasingly employed to take coal from under the final highwall following stripping. Among the new starters were multiple-head units for higher productivity.

Throughout the year a number of plans for remote control of face equipment were evaluated; at least one was actually in use (*Coal Age*, August, 1959, p 98).

Stripping

NEW TECHNIQUES, application of special machines and closer supervision of operations marked the course of events in strip mining in 1959. Operators relied on these and other steps to boost over-all efficiency and thereby solidify strip mining's position. New records were set by the latest wheel excavator operating with a 35-yd shovel in 65 to 100 ft of overburden. The year witnessed more 60- and 70-yd shovels going on stream in the race to move more material faster and more economically. And interest continued in the development of a 100-yd shovel and 100-ton truck.

Draglines ranging up to 35-yd in capacity were pacesetters in anthracite as well as at many bituminous operations. Capacity of coal haulers at big strip mines moved up and top speeds of 40 mph were common. More economical or efficient breaking of overburden continued in the foreground with gains registered in



CENTRALIZED CONTROL of coal preparation plants led to higher product quality and utmost economy in labor at new facilities.

blow-charging of blastholes and development of the seismic method of overburden analysis to determine rippability. Highwall augering maintained its position with multiple-head units gaining in recovering thin seams.

Breaking Overburden

A bulldozer with a hydraulic ripper that breaks up a 3- to 6-ft layer over the coal not only saves explosives and makes possible greater recovery of coal but also speeds up dragline operation by making possible loose, easy digging. In breaking the upper portion of the overburden, the company mechanically mixes its own blasting agent, using 1 lb of carbon black and 3 qt of fuel oil to 100 lb of ammonium nitrate. The company uses explosives alone to throw as much overburden as possible into the pits (*Coal Age*, January, 1959, p 82).

Close supervision of drilling and blasting practices speeds drilling of horizontal holes and makes possible placement of explosives where they are most needed at a Missouri operation. Prepackaged ammonium nitrate blasting agent with built-in primer simplifies charging of the horizontal holes (*Coal Age*, May, 1959, p 80).

A West Virginia company buys pre-oiled ammonium nitrate in 80-lb bags. Made up of half granules and half prills, the product is aged seven days. Company management reports that aging makes possible better penetration by the oil and thus promotes better detonation. A blow-charging machine packs the blasting agent into holes at the rate of one bag per minute (*Coal Age*, June, 1959, p 134).

Multiple-deck blasting yields maximum fragmentation with a minimum of explosives at an Ohio mine. Single-deck loading is practiced when overburden thickness is 45 ft or less; two-deck charging when cover is 47 to 70 ft thick; three-deck charging when cover is 70 to 100 ft thick; and four-deck charging when overburden is more than 100 ft thick. Milli-second connectors are used between holes and rows to enable the explosive to break rock more effectively (*Coal Age*, July, 1959, p 108).

One company uses a concrete-mixing truck to blend ammonium nitrate and fuel oil while traveling from the bulk storage facilities to the pit. The company buys ammonium nitrate in bulk and stores it in a bin from which it is fed to the mixing truck like cement. While a measured volume of nitrate flows into the truck, fuel oil also is metered and poured into the truck's mixing drum. A graduated measuring hopper under the truck's discharge chute makes possible accurate charging of blastholes.

A new technique employing a refraction seismograph now is available for making a quick easy and inexpensive analysis of strip overburden. The new process, called seismic analysis, is based on the principal that sound or shock waves travel through different subsurface materials at varying speeds.

By this method the strip operator can determine rippability of the overburden and, hence, the most economical method of breaking and removing it. He can tell if the material can be bulldozed and scraper loaded, or ripped and scraper loaded, or if it must be drilled and blasted for handling by a shovel or dragline. Two men, after a minimum of training, can perform a seismic study in a matter of hours (*Coal Age*, December, 1959, p 102).

Stripping

Shovel performance was improved at a Kentucky mine by increasing engine speed to 1,400 rpm from 1,100. This increase makes it possible for the engine to speed up to near normal operating range on the return swing and thus be ready for digging as soon as the shovel swings back to the overburden. The net result is a 5 sec decrease in the operating cycle (*Coal Age*, January, 1959, p 82).

Application of T-1 alloy steel for fabricating lip plates, gantry clevises, cable anchors, sheaves, bucket teeth, boom bases, gears and stiff-leg feet helps an Ohio operator increase the service life of parts and boost machine capacity (*Coal Age*, February, 1959, p 126).

Informative operating maps provide an important tool in planning pit operations for a 70-yd stripping shovel in Kentucky. Prospect holes on 330-ft centers, surface contours at 5-ft intervals and coal contours yield basic information for maps on a scale of 1 to 100. These maps made possible the successful removal of a 100-ft-high hilly area (*Coal Age*, March, 1959, p 98).

A fivefold increase in capacity over the original machine is achieved with the latest wheel excavator operating with a 35-yd shovel in 65 to 100 ft of overburden in Illinois. Capable of digging 3,500 cu yd per hour the wheel removes 10 to 15 ft of soft top material in low banks and at maximum depth handles one-third to one-half of the overburden (*Coal Age*, August, 1959, p 82).

Loading and Hauling

A longer boom and dipper stick and a "conning tower" for the oper-

ator were added to a 9-yd coal shovel to make possible loading of lower seam coal into 50-ton trucks operating on a seam 8 ft above. As a result of increasing the length of the boom from 38 to 50 ft and dipper stick from 23 to 28 ft, and raising the operator's cab to a position above the level of the house roof, the unit now has ample reach and the operator can see the coal dumped (*Coal Age*, September, 1959, p 122).

Application of a horizontal-thrust loader made possible a 2% reduction in ash content and simplified selective loading of a 36-in seam at an Iowa mine. The loader's level crowd action makes it possible for the operator to skim off the top bench without mixing in a 2-in clay parting with it. Similarly the shovel's action enables spoiling off the fire clay from the lower coal, which then can be loaded cleanly (*Coal Age*, November, 1959, p 142).

Service

A typical result of an Ohio operator's planned maintenance program for truck engines is 20,000 hr of operation by big 400-hp diesel engines before overhaul. This is double the life of most on-highway diesels. Keys to this success are: (1) backing of the program by top management, (2) trained maintenance men, (3) skilled machine operators, and (4) cooperation between maintenance men and operating men (*Coal Age*, June, 1959, p 82).

To simplify cold-weather starting of truck engines, another Ohio company uses electric engine heaters. These units keep the engines warm while they are parked outside the shop on nonloading shifts. The heater has an aluminum jacket enclosing a 2,500-W heating element and two openings that connect to the engine's cooling system. Drivers plug in the heaters after parking the trucks at the end of the shift. These units keep the water at 120 F. At the beginning of the following work shift the drivers disconnect the power, check the oil and then start the prewarmed engine and head for the pit (*Coal Age*, July, 1959, p 108).

To provide first-class roads that will stand the constant pounding of 70-ton coal haulers, a Wyoming company lays a 20-in rock road base in two steps. Both layers are compacted to a degree far surpassing bearing ratios and compaction values for conventional highways. Numbered passing turnouts make possible safe passing of loaded and empty trucks. Drivers are in constant communication by two-way radio so that the driver of an empty hauler on a return trip knows which turnout to enter to clear the road for the oncoming loaded unit (*Coal Age*, October, 1959, p 74).

The coal industry's first executive helicopter enables coal officials to visit in 2¾ hr 14 far-flung activities scattered over 300 sq mi of Pennsylvania, formerly requiring 14 hr driving. In addition to providing fast executive transportation, the helicopter proves extremely valuable where purchases or leases of coal lands are being considered. For example, the company's leasing agent and strip superintendent can fly over a property and spot the best location for drill holes and roads, estimate spoil areas and locate the best point to open a new pit (*Coal Age*, October, 1959, p 86).

New Anthracite Preparation Facilities in 1959

Coal Company	Plant Location	Capacity, TPH	Preparation Equipment
Anthracite Fine Coals, Inc.	Donaldson, Pa. (5)	200	Wilmot [1]
Atkins Coal Co.	Frackville, Pa.	75	Wilmot [2]
Bliss & Son	Hauto, Pa.	56	Deister Concentrator [3]
Franklin Coal Co.	Ravine, Pa.	105	Wilmot [2]
Jeddo-Highland Coal Co.	Jeddo, Pa.	250	Heyl & Patterson [4]
Locust Valley Coal Co.	Mahanoy City, Pa.	...	Roller [5]
Mineral Coal Co.	St. Clair, Pa.	16	Deister Concentrator [3]
Savitske Bros.	Mt. Carmel, Pa.	65	Western Machinery [6]
Thomas W. Schneck & Co.	Suedberg, Pa.	105	Wilmot [2]
Tunnel Ridge Coal Co.	Schuylkill, Pa.	16	Deister Concentrator [3]
Underkoffler Coal Service	Lykens, Pa.	75	Wilmot [7]

* Includes contracts for installations of new equipment in existing structures. Where more than one equipment unit was installed, the number, when known, appears in parentheses after the plant address.

1. Fine-coal plant, four Wilmot Hydrotators, one classifier. 2. Wilmot OCC heavy medium equipment. 3. SuperDuty Diagonal-Deck No. 7 coal washing tables, and one Model 208 Concenco revolving feed distributor.

4. Preparation plant including double-drum heavy-medium system, dewatering screens, H&P 14-in cyclones and H&P 24-in heavy-medium washing cyclones. 5. Ohmart gamma-ray specific gravity control.

6. Wemco Mobil-Mill heavy-medium equipment. 7. Wilmot OCC heavy-medium equipment with Accuray density control.

Preparation

MORE PRECISE control of clean-coal quality, automation wherever it could cut labor cost or improve plant performance, and continuing emphasis on fine-coal washing and drying highlighted the preparation picture in 1959.

Wet tabling with double-deck units led in fine-coal washing and froth-flotation units made major strides in recovering ultrafines. In coarse-coal washing, heavy-medium machines continued to chalk up gains and jigs ranked high in popularity. Interest also continued in calcium-chloride washers and upward-current classifiers as major preparation units. And more operators installed water-clarification equipment, such as, cyclones, thickeners and filters as anti-pollution enforcement became more strict.

Increased strength and yield of coke and an ensuing boost in blast-furnace output result from upgrading a blend of three high volatile coals in a new Utah 600-tph cleaning-in-transit plant (*Coal Age*, February, 1959, p 112).

Electropneumatic car retarders at a 720-tph Kentucky plant control all movements as railroad cars pass to the loading chute, are loaded, run to the scale and then come to rest at a collecting point for delivery to the storage yard (*Coal Age*, February, 1959, p 118).

A fluidized-bed heat dryer at another Kentucky plant processes 175 tph of ⅝x0, reducing moisture from 14½ to 4½%. Feed is ⅜ x 0 clean coal which has been dewatered by centrifuges, plus 15 tph of ⅝x⅜. Coarse-coal particles in the reactor compartment are kept in teeter by the high velocity of drying air, and fines are blown up to a battery of six cyclones. Coal flows across the reactor without the aid of a conveyor (*Coal Age*, March, 1959, p 104).

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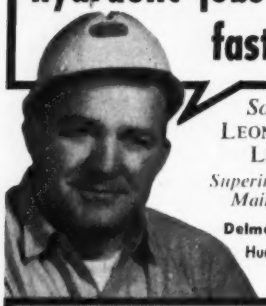

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empties down from the empty hill and loads away from the preparation plant are two major benefits of a switch engine-conveyor system recently patented. The system employs a diesel switching engine on which is mounted a trough-type reversible belt that extends a short distance beyond the couplers. This combination makes possible grouped railroad car exchanges under the loading chute without interrupting the flow of coal to the cars (*Coal Age*, March, 1959, p 116).

Screen blinding was eliminated by converting a double-deck vibrator into a triple-deck unit and adding a heating unit to the bottom deck. The new arrangement works without blinding in practically all weather, even with up to 6% moisture in the coal (*Coal Age*, March, 1959, p 118).

A new 200-tph fine-coal cleaning and drying plant enabled a West Virginia company to solidify its position in the metallurgical market as well as increase the recovery of ¼x0 coal. Operated by two men, the plant incorporates special facilities, such as, centralized lubrication, oil treating and freezeproofing systems, freight and man elevators, central vacuum system for cleanup work, telephone and loud-speaker communication systems (*Coal Age*, April, 1959, p 102).

A dense-medium washer with automatic density control and a feldspar jig solved a tough washing problem at another West Virginia operation. Starting with a raw feed containing 50% reject and 18 to 26% ash, the new plant makes a product with 8 to 8½% ash, 1.7% sulphur, 13,700 Btu as received and 2,700 F fusion temperature (*Coal Age*, May, 1959, p 70).

An automatic car haul that moves 35 cars in a string and is operated from the loading point above and between the two loading tracks, eliminates the need for car droppers at Missouri plant (*Coal Age*, May, 1959, p 80).

One man has at his fingertips control of 90% of a 1,500-tph Virginia plant featuring four independent coarse- and fine-coal washing circuits. New nucleonic density controls on heavy-medium washers assure consistently uniform quality of coal as well as reduce manpower needs. Automatic pneumoelectric retarders control railroad cars as they move from rotary unloading dump to loading tracks. Other plant features include automatic sampling, individual ammeters for motors, hour-meters for plant units and special materials to cut maintenance costs (*Coal Age*, July, 1959, p 80).

A new entrainment dryer reduces moisture 2.9% on minus 10-mesh at an Illinois plant. Principal advantages cited for the 200-tph unit include: (1) no danger of an explosion because the atmosphere throughout the dryer is inert; (2) rapid starting and stopping; and (3) high thermal efficiency. Coal dust is used as fuel (*Coal Age*, August, 1959, p 102).

New fine-coal preparation facilities employ gravity flow as much as possible and gentle handling within the preparation units themselves to minimize degradation of a friable West Virginia coal. Coal's largest horizontal rotary filter dewaters ⅜x0, yielding a product with 16% moisture (*Coal Age*, September, 1959, p 94).

A new heavy-media anthracite plant employs an adjustable crusher for regulating size consist of plant yield to meet fluctuating demand for various sizes. Storage facilities provide maximum flexibility in servicing truck customers (*Coal Age*, October, 1959, p 114).

A new rotary-kiln dryer has increased plant efficiency, lowered operating and maintenance costs, and improved coal quality at a West Virginia plant (*Coal Age*, November, 1959, p 118).

Dual washing and tabling circuits, cyclones rather than drag tanks for thickening prior to tabling, control from three stations with three operators, automatic sampling, a closed water circuit and automatic control of raw-coal feed mark a 15,000-tpd West Virginia plant (*Coal Age*, December, 1959, p 92).

Added starters in preparation include rubber-coated screens which are said to outlast conventional materials from 5 to 1 up to 20 to 1; rubber replacement covers with riffles attached for wet washing tables; a new device that will completely discharge cakes too thin for other filters without blow-back or internal cloth binding; a short-stroke horizontal picking table for refuse requiring 30% less power to operate and less maintenance than a conventional picking table; heavy-medium cyclone washers; and at least two types of nucleonic density controls for use with heavy-medium systems.

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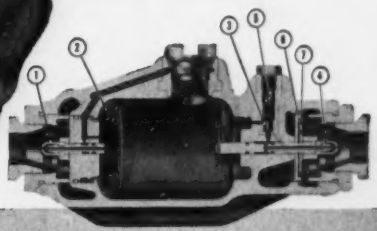

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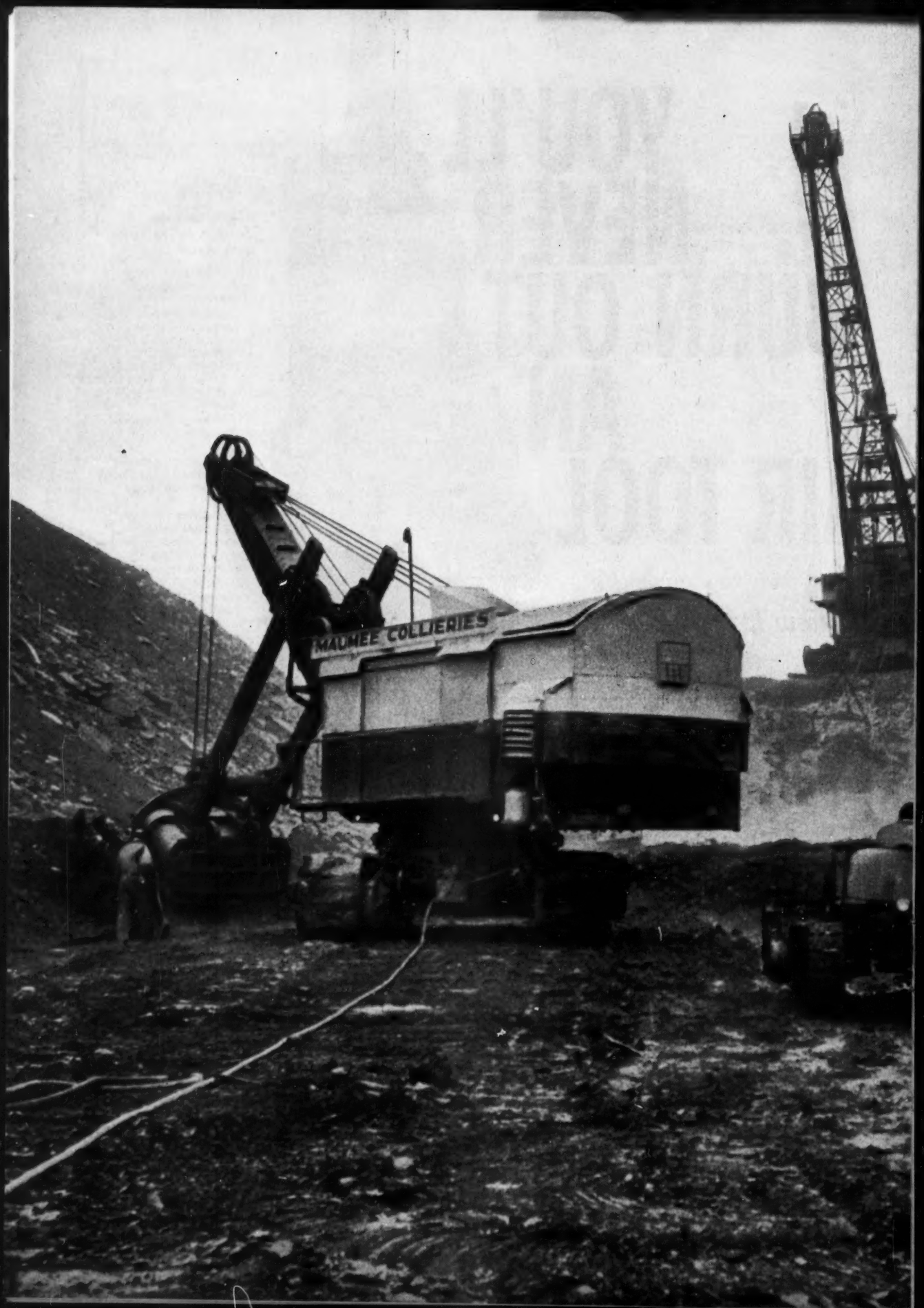
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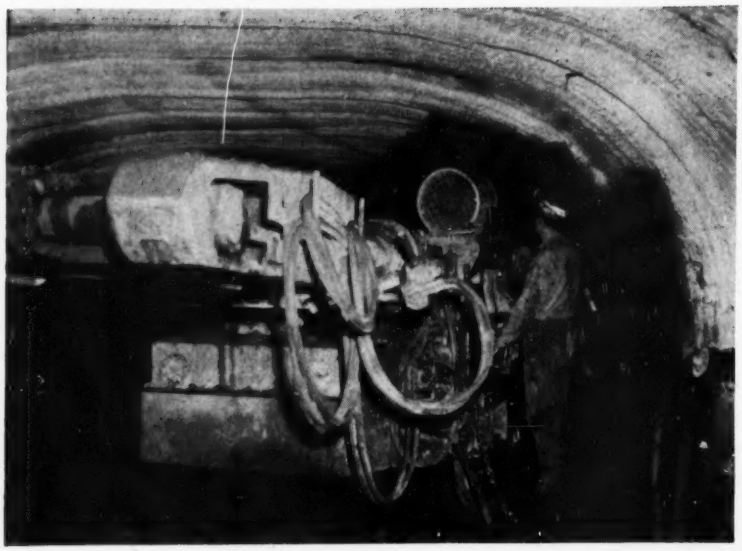


DEVELOPMENT OF EQUIPMENT for increased safety with continuous mining was a major activity in 1959.

Safety in 1959

THE BIG NEWS in mine safety in 1959 was the industry's achievement of the lowest rate in history with respect to fatalities per million tons. The rate of 0.68, as shown in the accompanying table, represents a a major breakthrough, attributable in no small degree to coal's mechanization program. Not to be minimized are the old standby's in safety promotion—effective training and education, strict inspection and close supervision—which, in combination with continuing emphasis on mechanization and property improvement, will lead to still greater advances in safety.

The magnitude of the 1959 achievement becomes more evident when it is recalled that 593 men lost their lives in the Nation's coal mines in 1949, compared with 290 last year. Two decades ago, in 1939, the fatality toll was 1,106 men in the single year. The investment of time, talent, effort and money in safety work, by all agencies, has been worthwhile and productive.

However, the loss of 290 men last year permits of no complacency. There is much to be done. Indicators of this need for continuing action in safety are (1) fatalities resulting from haulage accidents continued to kill miners at a rate comparable with 1958, (2) two disasters struck early in the year and (3) roof falls still continue to account for half or more of coal's fatalities. On Jan. 22, 1959, the Susquehanna River broke into a slope mine of the Knox Coal Co., near Pittston, Pa., causing the deaths of 12 anthracite mineworkers. On Mar. 23, a gas explosion in a Tennessee mine claimed the lives of nine men.

Among the lessons to be learned from these events are: Haulage accidents have not been finally overcome; people still carry open lights into coal mines; good engineering is one of the major ingredients in a good safety record. The response to this situation must be, as always, effective training and education, strict inspection and close supervision, as stated before.

Continuing Action

The response is forthcoming. Development of training programs has kept pace with the need; inspection schedules have been tightened by companies and government agencies, and the reductions in crew size which accompany continuous mining are leading to closer supervision.

Furthermore, the product engineers of the manufacturers who serve the coal industry are coming up with new developments in equipment that should aid the cause. And a number of coal companies are conducting methods-and-equipment research that will undoubtedly result in improved health and safety conditions in mining.

For example, one company in western Pennsylvania employs a remote-control device for ripper type miners which provides for a programmed reaction from the machine when the control is operated from a distance. The system was developed for use in pillar-recovery work, making it possible for the operator to clear out immediately if an uncertain roof condition develops and to retract the machine later from an outby position of safety. The programming consists of centering the ripper head, if it is not centered, and tramming the machine back. A full description of this forerunner of 100% remote control appears in *Coal Age*, August, 1959, p 98.

Increased safety in the use of trailing cables underground is provided in a new monitoring unit (*Coal Age*, January, 1960, p 88) which interrupts power at the outby end of the cable in the event of a fault. Another application of electronics may offer a practicable answer to the problem of automatic methane detection and the necessary follow-up, power shutoff.

Roof-Control Progress

Self-advancing roof shields for use in the immediate face with continuous miners were among the features unveiled at the AMC Coal Show last May. These shields are hydraulically operated from the circuits of the mining machine itself, and their purpose is to provide dependable protection in the most critical area in a mine with respect to the roof-fall hazard. Other studies throughout the year deal with the possible application of special railroad lock washers as roof-bolt tension indicators. These washers close at a predetermined wrenching force and reopen if bolt tension is relieved for any reason. Their advantages include ease of installation, simplicity in reading and economy, aside from their primary benefit of signalling losses in bolt tension.

One company, applying available data to an important safety purpose, used the logs of drill cores to pro-

U.S. Coal-Mine Fatalities in 1959 and 1958[1]

Cause and Location	Bituminous				Anthracite				Total			
	Fatalities		Rate[2]		Fatalities		Rate[2]		Fatalities		Rate[2]	
	1959	1958	1959	1958	1959	1958	1959	1958	1959	1958	1959	1958
Falls of roof	128	153	0.31	0.37	13	18	0.66	0.85	141	171	0.33	0.40
Falls of roof from equipment knocking out support	2	3	...[4]	.01	...	1	...	.05	2	4	...[4]	.01
Falls of face, side rib, or pillar	6	3	.01	.01	5	1	.26	.05	11	4	.02	.01
Falls of roof or face, etc. from bumps, bursts	1	4	...[4]	.01	...	...	...	...	1	4	...[4]	.01
Inrush of water or material	...	...	...	...	12	...	.61	...	12	...	.03	...
Haulage	35	43	.08	.10	8	...	.41	...	43	43	.10	.10
Explosions: Minor	1	5	...[4]	.01	...	1	...	.05	1	6	...[4]	.01
Major	9	36	.02	.09	...	...	...	...	9	36	.02	.08
Explosives	4	7	.01	.02	2	1	.10	.05	6	8	.01	.02
Electricity	7	14	.02	.03	...	...	...	...	7	14	.02	.03
Machinery	13	11	.03	.03	...	...	...	...	13	11	.03	.02
Mine fires	...	3	...	.01	...	...	...	...	...	3	...	.01
All other	3	5	.01	.01	1	4	.05	.19	4	9	.01	.02
Total underground	209	287	.51	.70	41	26	2.10	1.23	250	313	.58	.72
Surface: Haulage	7	9	.02	.02	1	2	.05	.09	8	11	.02	.02
Electricity	3	...	.01	...	...	...	...	...	3	...	.01	...
Machinery	3	2	.01	...[4]	2	1	.10	.05	5	3	.01	.01
All other[3]	4	7	.01	.02	1	...	.05	...	5	7	.01	.02
Total surface	17	18	.04	.04	4	3	.20	.14	21	21	.05	.05
Strip mines: Haulage	4	5	.01	.01	...	2	...	.09	4	7	.01	.02
Electricity	3	1	.01	...[4]	...	...	...	...	3	1	.01	...[4]
Machinery	6	4	.01	.01	...	...	...	...	6	4	.01	.01
All other	5	6	.01	.01	1	1	.05	.05	6	7	.01	.02
Total strip	18	16	.04	.04	1	3	.05	.14	19	19	.04	.04
Auger mines: Falls of roof or face	...	...	...	...	...	...	...	...	...	...	...	...
Haulage	...	...	...	...	...	...	...	...	...	...	...	...
Explosions: Minor	...	...	...	...	...	...	...	...	...	...	...	...
Major	...	...	...	...	...	...	...	...	...	...	...	...
Machinery	...	2	...	...[4]	...	...	...	...	...	2	...	...[4]
Suffocation	...	...	...	...	...	...	...	...	...	...	...	...
All other	...	1	...	...[4]	...	...	...	...	...	1	...	...[4]
Total auger	...	3	...	.01	...	...	...	...	...	3	...	.01
Grand total	244	324	.60	.79	46	32	2.35	1.51	290	356	.68	.82

[1] All figures are subject to revision. [2] Fatalities per million short tons. [3] Includes 1 surface fatality resulting from fall of roof underground in Kentucky, 1958. [4] Less than 0.005. (Source: U. S. Bureau of Mines.)

vide information on the varying thicknesses of strata overlying mining operations. It has been noted that this helps company engineers to anticipate areas of possible roof trouble, especially where sandstones become excessively thick and strong. The holes had been drilled previously on a regular grid system, primarily to ascertain the quality of coal in a virgin area.

In addition to developing equipment for better roof control, the industry formulated plans for a 1960 campaign to reduce by 50% the frequency of injuries resulting from roof falls. A similar campaign in 1957-8 was highly successful; there were 509 fewer injuries from roof falls during that period than during a comparable base period. All these efforts raise the hope that the No. 1 Killer in coal mines will be successfully brought under control.

People and Programs

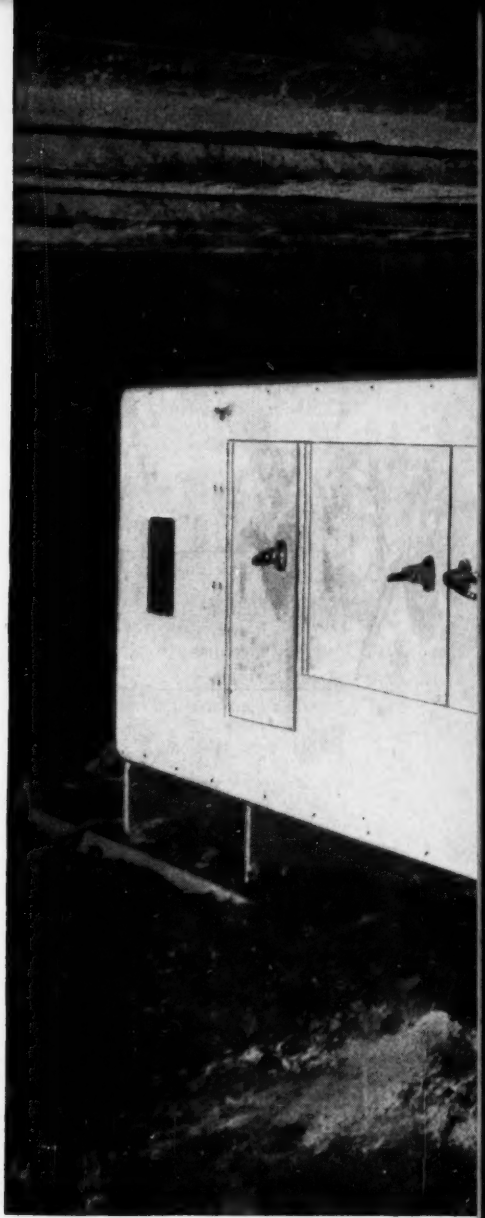
The first-aid team from Compass No. 1 mine, Clinchfield Coal Corp., Clarksburg, W. Va., won top honors at the National First-Aid and Mine Rescue Contest at Buffalo, N. Y., Oct. 5-7, 1959. The mine-rescue team from Mine No. 22, Bethlehem Mines Corp., Jenkins, Ky., scored highest in the mine-rescue competition. More than 35 teams journeyed to Buffalo for the biennial contest.

Winners of Sentinels of Safety trophies, awarded by *Explosives Engineer* magazine, a publication of Hercules Powder Co., were, in anthracite, Germantown colliery, Raven Run Coal Co., Centralia, Pa., and in bituminous, Mine No. 14, United States Steel Corp., Gary, W. Va. The Bureau of Mines keeps the records.

A number of mines reported 100% completion of Bureau of Mines retraining in accident prevention, and the Bureau offered a new course in the fundamentals of accident prevention.

Early in the year Gov. Stratton of Illinois announced that the mines of Illinois had compiled the best safety record in the state's history during 1958. The final records for the year showed that there was an unprecedented period of 174 days in that year without a fatality. Over this period 15,563,797 tons of coal were mined.

ONLY WESTINGHOUSE CONSTRUCTION SUITABLE FOR WORLD'S LARGEST SEALED DRY-TYPE MINE POWER CENTER



MINE power center specifications are extremely exacting . . . so exacting that only Westinghouse, the leader in the field, offered a construction found suitable for the world's largest sealed, portable mine power center.

Only Westinghouse construction could combine—in a unit with the desired 600-kva, 7200/480-volt rating—the necessary ruggedness, compact low height and light weight essential to easy portability within mine tunnels.

Here are the key features in this construction:

External ruggedness—A ¼-in. steel plate case protects against roof falls, rough use. A ⅜-in. base plate with ½-in. reinforcing skid runners protects the unit when skidded over rough bottom, haulage tracks, etc., during frequent relocation.

Internal ruggedness—Core and coils braced at both top and bottom to withstand full short circuit conditions, securely mounted in case to withstand moving and rough handling.

Low height—The most compact mine power centers made, the 600-kva unit is only 42 inches high, the 300-kva unit only 36 inches.

Low maintenance cost—Nitrogen-filled, sealed, dry-type power center is practically maintenance-free; protected against moisture even when de-energized during prolonged shutdowns.

This sealed mine power center is but one of the complete line of Westinghouse power centers available to serve the mining industry above the surface, as well as below. Ask your Westinghouse representative about the power center to serve your specific applications.

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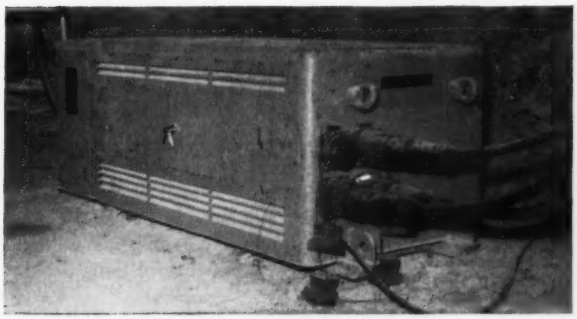
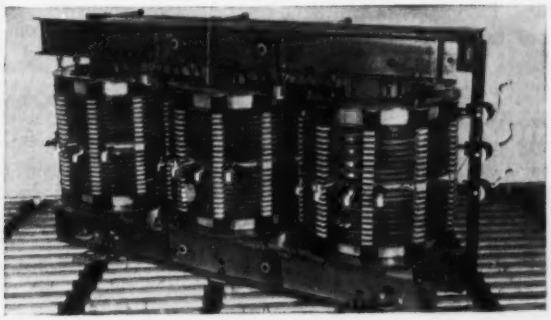
Convenient location of the high-voltage receptacle on world's largest sealed mine power center permits hitching to low-voltage end when unit is skidded to a new location. This allows unit to remain energized; high-voltage cable can pull straight without bending, and buggy can obtain its motive power from one of the secondary feeders.

A full range of ratings in ventilated mine power centers is available from Westinghouse for application where conditions are less severe—such as less dust, lower humidity.



Core and coil assembly for 600-kva, 7200/480-volt, 3-phase unit—world's largest sealed mine power center made by Westinghouse.



1959 Sales of Coal-Mine Equipment

By **W. H. Young,** Chief, Bituminous-Coal and Lignite Section

And **R. L. Anderson,** Supervisory Commodity-Industry Analyst, U. S. Bureau of Mines

SHIPMENTS of mechanical loading equipment for underground use in coal mines in the United States, in terms of capacity, increased 17% in 1959 from 1958. The capacity of mechanical cleaning equipment sold for use at bituminous coal mines was 13% less in 1959 than in 1958.

This survey was made possible by the cooperation of manufacturers of mechanical cleaning equipment for bituminous coal mines and of mechanical loading and supplementary haulage equipment and coal-recovery augers for use in all coal mines in the United States. Information from trade journals also was used.

Sales of mechanical loading units, coal-recovery augers, and supplementary haulage equipment in 1959, as in previous years, represent shipments during the year. Of the total capacity of mechanical cleaning equipment sold in 1959, 50% was placed in operation during that year; the remainder (50%) will be installed later.

Mechanical Loading and Mining

Bituminous coal and lignite mechanically loaded in underground mines decreased from 244 million tons in 1958 to an estimated 239 million tons in 1959. Production at strip mines increased from 116 million tons to an estimated 123 million tons and at auger mines from 7 million to 8 million tons during the same period.

Table I shows data on bituminous coal and lignite production, by methods of mining, and mechanical cleaning for 1957-59, inclusive. The percentage of total production of bituminous coal and lignite in the United States, 1937-59, by type of mining and loading is shown on Fig.1. During 1959, more than 90% of the total output was mechanically loaded at underground mines, loaded by power shovels at strip mines, or mined by augers along highwalls in strip mines.

Underground production of bitumi-

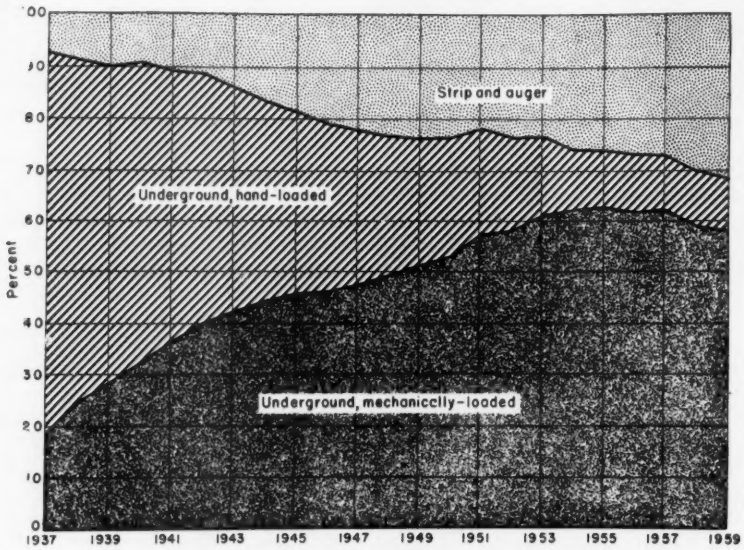


FIG. 1—PERCENTAGE OF TOTAL PRODUCTION of bituminous coal and lignite in the U. S., 1937-59, by types of mining and loading.

TABLE I—U.S. Bituminous and Lignite Production, By Methods of Mining and Cleaning, 1957-59

	1957		1958		1959*	
	Thousand Net Tons	Percent	Thousand Net Tons	Percent	Thousand Net Tons	Percent
Hand-loaded underground	54,912	11.1	43,311	10.6	40,000	9.8
Mechanically loaded underground	305,737	62.1	243,573	59.3	239,000	58.3
Mined at auger mines	7,946	1.6	7,320	1.8	8,000	1.9
Mined by stripping	124,109	25.2	116,242	28.3	123,000	30.0
Total production	492,704	100.0	410,446	100.0	410,000	100.0
Mechanically cleaned	304,027	61.7	259,035	63.1	260,000	63.4

*Preliminary.

TABLE II—Underground Bituminous and Lignite Production, By Methods of Loading, 1957-59

	1957		1958		1959[1]	
	Thousand Net Tons	Percent	Thousand Net Tons	Percent	Thousand Net Tons	Percent
Mobile loading machines:						
Loading direct into mine cars	24,797	6.9	13,658	4.8	...[2]	...[2]
Loading onto conveyors	14,419	4.0	13,563	4.7	...[2]	...[2]
Loading into shuttle cars	197,506	54.8	150,792	52.6	...[2]	...[2]
Continuous mining machines	53,783	14.9	56,373	19.6	...[2]	...[2]
Scrapers	81	....	11	....	...[2]	...[2]
Conveyors equipped with Duckbills or other self-loading heads	2,699	.7	1,550	.5	...[2]	...[2]
Hand-loaded conveyors	12,452	3.5	7,626	2.7	...[2]	...[2]
Total mechanically loaded	305,737	84.8	243,573	84.9	239,000	85.7
Hand-loaded into mine cars	54,912	15.2	43,311	15.1	40,000	14.3
Total underground production	360,649	100.0	286,884	100.0	279,000	100.0

[1] Preliminary. [2] Included with "Total mechanically loaded."

nous coal and lignite, by methods of loading, is listed in Table II. The estimated percentage of underground production mechanically loaded in 1959 was higher than in the preceding year.

Auger Mining—Augers are used for coal recovery along highwalls in strip mines and on bench operations where coal cannot be economically mined by stripping. Separate data on the number of augers in use and the tonnage produced by auger mining were first collected for 1952.

Reports from four manufacturers of coal-recovery augers show that 47 augers were shipped in 1959 compared with 45 in 1958, an increase of 4%. All augers shipped in 1959 were for surface use. Table III shows coal-recovery auger shipments in 1955-59, and Table V the number in use in 1958 and shipments in 1959, by states.

Types of units sold—Table III lists the units of mechanical loading and mining equipment shipped for use at coal mines in the United States, 1955-59, inclusive. Shipments of continuous mining machines, coal-recovery augers, shuttle cars, and gathering and haulage conveyors increased, while room or transfer conveyors and bridge conveyors decreased in 1959 from 1958. Shipments of mobile loading machines were the same in both years. There were no scraper loaders shipped in 1959.

Exports of underground mechanical loading equipment in 1959, in terms of capacity, amounted to 17% of the shipments to mines in the U.S. compared with 15% in 1958.

Types of Mechanical Loading Equipment Sold Compared With Units in Use—Table IV shows the trend in demand for various types of mechanical loading equipment. Continuous mining machines were first used in 1948. However, they were not shown separately until 1952. The number in use has increased every year from 1952 to 1958. Shipments of continuous mining machines in 1959 were 21% of the number in use in 1958. Mobile loading machine shipments in 1959 were 3% of the number in use in 1958.

Table V shows the number of mechanical loading units and coal-recovery augers shipped to various states in 1959 compared with the number in use in 1958, as reported by mine operators. Sales of room conveyors as listed in Table V are not exactly comparable with the number of room conveyors in use. To avoid duplication in tonnage mechanically loaded, each mine operator was instructed to report "hand-loaded" and "self-loading" conveyor tonnage only. Therefore, conveyors loaded by mobile loading machines and continuous mining machines are not included with "Room conveyors in use in 1958." Shipments of coal-recovery augers to bituminous coal mines in 1959 were 14% of the total number in use in 1958.

TABLE III—Mechanical Loading and Mining Equipment Sold for Use in Coal Mines, as Reported by Manufacturers

	1955	1956	1957	1958	1959	Change from 1958 (percent)
Bituminous coal and lignite mines:						
Mobile loading machines	120	239	209	97	95	− 2.1
Continuous mining machines	109	154	168	107	140	+30.8
Coal-recovery augers	65	89	53	42	47	+11.9
Scrapers[1]	...	...	...	1	...	....
Shuttle cars	348	560	488	181	233	+28.7
Gathering and haulage conveyors[2]	78	137	172	97	118	+21.6
Room or transfer conveyors[3]	143	232	159	92	65	−29.3
Bridge conveyors	...[4]	128	96	66	61	− 7.6
Anthracite mines (Pennsylvania):						
Mobile loading machines	1	...	1	...	2	....
Continuous mining machines	...	...	1	...	...	....
Coal-recovery augers	1	...	2	3	...	....
Scrapers[1]	2	...	...	...	...	....
Shuttle cars	8	2	2	...	...	....
Gathering and haulage conveyors[2]	3	...	2	...	4	....
Room or transfer conveyors[3]	7	19	45	21	23	+ 9.5
Bridge conveyors	...[4]	...	1	...	2	....
Number of manufacturers reporting	22	22	21	18	17	....

[1] Reported as scrapers or scraper haulers and hoists.
[2] Includes all haulage conveyors with a capacity over 500 ft., except main slope conveyors.
[3] Includes all haulage conveyors with capacity of 100 to 500 ft., except main slope conveyors.
[4] Not available.

TABLE IV—Sales of Mechanical Loading Equipment in 1959 Compared With Machines in Use in Preceding Years

	Number Machines Reported In Use					Sales,
	1954	1955	1956	1957	1958	1959
Bituminous coal and lignite mines:						
Mobile loading machines	4,314	3,819	3,854	3,755	3,434	95
Continuous mining machines	325	385	510	614	679	140
Scrapers	48	23	35	14	7	...
Conveyors equipped with Duckbills or other self-loading heads	633	487	437	361	242	...[1]
Hand-loading room conveyors, number of units	2,162	1,925	1,819	1,528	1,230	65
Anthracite mines (Pennsylvania):						
Mobile loading machines	68	79	80	66	51	2
Scrapers	359	279	303	295	290	...
Hand-loaded room conveyors, number of units[2]	2,277	1,940	1,593	1,437	1,234	23

[1] Sales of conveyors equipped with Duckbills or other self-loading heads are included with hand-loaded room conveyors.
[2] Includes pit-car loaders and conveyors equipped with Duckbills or other self-loading heads.

Haulage Equipment

Bridge conveyors—Sales of bridge conveyors decreased 5%, from 66 in 1958 to 63 in 1959. Shipments by states are listed in Table VI.

Shuttle cars—Sales of shuttle cars increased from 181 in 1958 to 233 in 1959. Details of shipments to various states in 1958 and 1959 are given in Table VI. Exports of shuttle cars in 1959 amounted to approximately 14% of the 1959 sales in the United States.

Gathering and haulage conveyors—For the purpose of this study, "Gathering and haulage conveyors" include

TABLE V—Mechanical-Loading and Mining Equipment in Use in 1958, by States, Compared With Sales Reported in 1959

	Mobile Loading Machines		Continuous Miners		Scrapers		Room Conveyors[1]		Coal-Recovery Augers	
	In Use, 1958	Sales, 1959	In Use, 1958	Sales, 1959	In Use, 1958	Sales, 1959	In Use, 1958	Sales, 1959	In Use, 1958	Sales, 1959
Alabama	111	5	18	3	..	..	80	6	2	1
Alaska	2	..	..	..	..	..	..	..	..	..
Arkansas	2	..	1	1	..	..	24	..	..	..
Colorado	57	..	10	2	1	..	145	..	..	..
Illinois	144	..	38	1	..	..	10	..	3	1
Indiana	71	3	4	2	..	..	..	..	..	..
Iowa	5	..	..	..	..	..	..	..	..	..
Kentucky	501	5	38	3	..	..	50	2	82	21
Maryland	..	..	..	..	..	..	18	..	..	..
Montana, bituminous	10	..	..	..	..	..	10	..	..	..
New Mexico	2	3	..	6	..	..	1	..	..	..
Ohio	104	5	34	4	..	..	27	3	50	7
Oklahoma	5	..	..	..	..	..	78	..	..	..
Pennsylvania	661	6	303	60	..	..	419	10	38	7
Tennessee	28	..	..	..	..	..	31	1	18	2
Utah	138	..	19	3	..	..	4	..	..	..
Virginia	186	14	18	..	..	..	22	3	39	1
Washington	5	..	6	..	..	..	26	..	..	..
West Virginia	1,385	54	189	55	..	..	494	40	107	7
Wyoming	17	..	1	..	6	..	33	..	..	..
Total	3,434	95	679	140	7	..	1,472	65	339	47
Anthracite mines (Pennsylvania)	51	2	..	..	290	..[2]	1,234	23	..[3]	..
Grand total	3,485	97	679	140	297	..	2,706	88	..[3]	47

[1] Includes hand-loaded conveyors and conveyors equipped with Duckbills or other self-loading heads.

[2] Also includes pit-car loaders.

[3] Data not available.

TABLE VI—Units of Conveying Equipment Sold for Use in Coal Mines, 1958-59, by States

	Bridge Conveyors		Shuttle Cars		Gathering and Haulage Conveyors[1]	
	1958	1959	1958	1959	1958	1959
Alabama	6	6	7	24	1	10
Alaska	..	..	..	..	..	5
Arkansas	..	1	..	..	..	..
Colorado	..	..	3	5	..	1
Illinois	..	..	4	3	5	1
Indiana	..	..	8	..	8	2
Kentucky	3	1	39	10	7	6
New Mexico	..	..	2	6	..	1
Ohio	1	1	2	8	..	..
Oklahoma	..	..	..	..	..	2
Pennsylvania	11	10	18	43	14	16
Tennessee	..	2	..	..	..	2
Utah	..	..	7	..	1	2
Virginia	1	..	24	25	18	11
West Virginia	44	40	67	109	43	59
Total	66	61	181	233	97	118
Anthracite mines (Penna.)	..	2	..	..	..	4
Grand total	66	63	181	233	97	122

[1] Includes all gathering and haulage conveyors with capacity over 500 ft., except main slope conveyors.

TABLE VII—Bituminous Coal Mechanically Cleaned in 1958, Compared With 1959 Sales of Equipment

	1958			Annual Capacity of Equipment Sold in 1959 (Net Tons)[1]
	Number Plants in Operation	Net Tons Cleaned Coal	Output Mechanically Cleaned (percent)	
Alabama	32	10,019,196	89.6	...[2]
Alaska	3	323,650	42.6	...
Arkansas	..[3]	...[3]	...[3]	...
Colorado	3[4]	1,112,421[4]	33.3[4]	...[2]
Illinois	61	41,440,230	94.4	1,488,000
Indiana	19	10,503,303	69.9	...
Kansas	4	753,793	91.6	...
Kentucky	79	41,065,537	61.9	2,132,000
Missouri	9	1,881,331	72.6	...
Montana	2	8,234	3.9	...
New Mexico	1	16,702	14.3	...
Ohio	24	14,651,854	45.7	...
Oklahoma	3	538,607	33.1	...
Pennsylvania	94	39,957,169	59.0	2,192,000
Tennessee	4	297,455	4.4	...
Utah	6	3,362,093	63.1	...
Virginia	30	10,566,897	39.4	...
Washington	5	240,094	95.2	...
West Virginia	192	82,258,768	68.9	3,685,000
Wyoming	2	37,517	2.3	...
Undistributed	..	...	..	2,128,000
Total	573	259,034,851	63.1	11,625,000

[1] Based on average days mines were active in 1958 and 7.0 hours per day.

[2] Included in "Undistributed."

[3] Included in Colorado.

[4] Includes Arkansas.

sectional, extensible, power-driven conveyor units that can handle over 500 ft of conveyor. Main slope conveyors are excluded. Table III lists sales for 1955-59, inclusive, and Table VI shows shipments by states in 1958 and 1959.

Mechanical Cleaning

Reports from 21 manufacturers of bituminous coal cleaning equipment show that the total capacity of 1959 sales was 9,025 net tons of clean coal per hour compared with 10,350 tons of capacity sold in 1958, a decrease of 13%. Sales in 1959, by type of equipment, in terms of capacity, show that jigs ranked first, followed by dense medium and wet tables. The capacity of all types of equipment sold in 1959 for cleaning bituminous coal was equivalent to 5% of the bituminous coal cleaned in 1958. Approximately 64% of the total capacity of cleaning equipment sold in 1959 was for additions or replacements to present installations and the remaining 36% was for new plants.

Table VII gives data on bituminous coal cleaned in 1958, and the annual capacity of equipment sold in 1959, by states.

Bethanized Coating Protects Wire Rope in Koepe Hoist—You're looking at Bethlehem Wire Rope serving on a Koepe hoist at the Cliffs Shaft Mine of Cleveland-Cliffs Iron Company. This installation calls for something special in rope service, because lubricants on the operating ropes have to be held to the minimum. And conditions in the shaft are "wet." The rope (a flattened strand for the hoist cables and a special non-rotating type for the tail lines) has been in service for months, thanks to the outstanding corrosion-resistance of the bethanized coating. This is a heavy-duty armor which protects the steel wires with a smooth, uniform layer of pure zinc.

Bethlehem Wire Rope made with bethanized wire has another important advantage in mining applications due to the ductile zinc coating serving as an internal lubricant for the rope. Bethlehem produces wire rope in a variety of bethanized coating weights, so as to meet virtually any type of operating condition.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Distributor: Bethlehem Steel Export Corporation*

Mill depots and distributors from coast to coast stock Bethlehem Wire Rope

BETHLEHEM STEEL

WORKING FACE in area being mined with continuous miner measures 31 in.

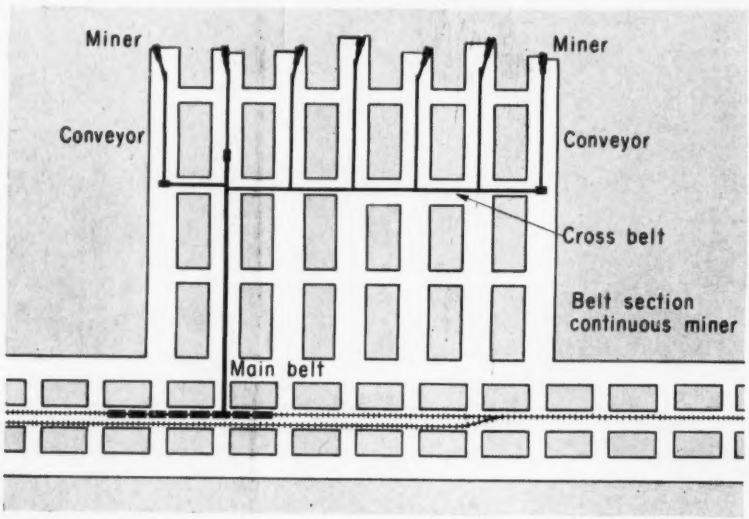
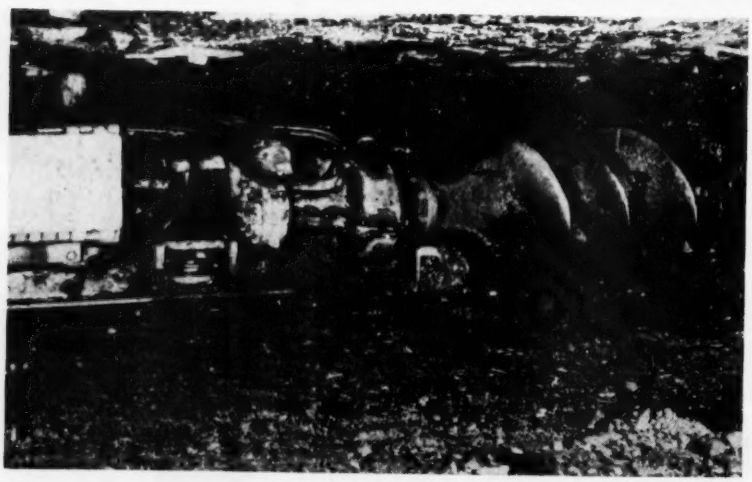


FIG. 1—FUTURE PLANS call for seven miners and extensible room belts which will feed coal onto main belt leading to car-loading point.



MACHINE OPERATION is same as shortwall cutter. Unit is sumped 3 ft at either rib, then moved across the face.

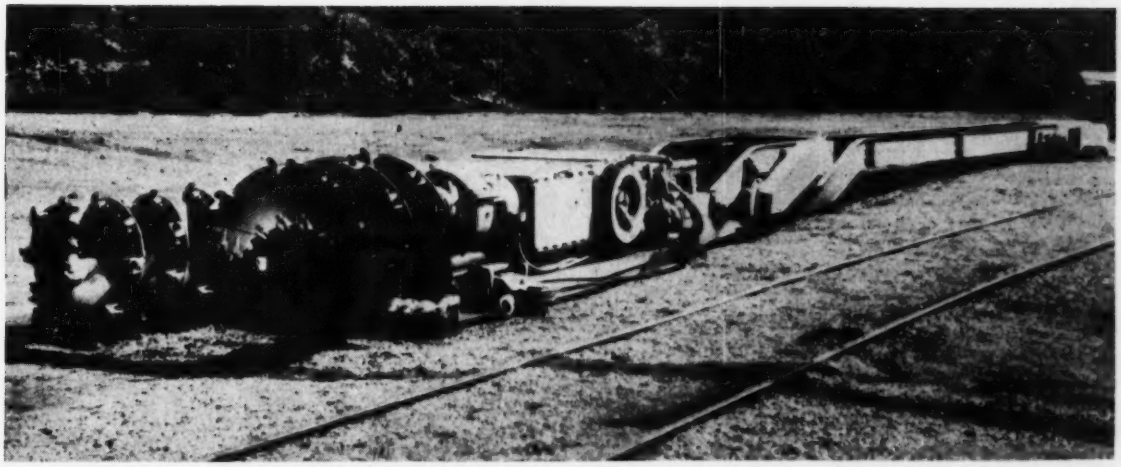
Greater safety and higher productivity are major benefits as . . .

Thin-Seam

Coordinated efforts in applying continuous mining machines bring TCI a long way toward solving the problem of mining thin coal. Roof-control problems no longer hinder face operations as section output increases 150% in rooms and 94% in development.

Coal Mines Staff
Tennessee Coal & Iron Div.
United States Steel Corp.
Fairfield, Alabama

THIN-SEAM MINING at Tennessee Coal & Iron Div., United States Steel Corp. has practically become synonymous with high cost coal; however, this coal constitutes some of the highest quality coking coal in the Birmingham area. Inasmuch as thin seams constitute about one-third of TCI's coking coal reserves and this coal is needed for blending with



AUGER-TYPE continuous miner with two 24-in heads is latest machine currently used in thin-seam production at TCI.

Continuous Mining Pays Off at TCI

other coals to supply a satisfactory feed for our coke ovens, it has been deemed essential that thin seam production continue. This will, over the years, assure the coals for the proper admixture to produce satisfactory coke.

Since it is necessary that we must mine thin seam coal, it is imperative that cost per ton be reduced.

Mining of low coal has been a story of steady progress over the past years, but nevertheless it has lagged far behind the mechanization of the thick seam mining. From hand loading directly into mine cars at the face, TCI progressed, through this transition, by utilizing various types of equipment combinations. Most of these methods still left a great deal of hand labor to be performed. A list of developments in thin seam mining that have been or are being used in our mines would include hand-loaded drags, scrapers, chain and shaking conveyors loaded by hand, duckbills loading shaking conveyors, low-capacity mobile equipment loading shaking conveyors, low-vein mobile equipment loading shuttle cars and many types of auxiliary equipment that are used with these units. Although low-vein mobile equipment is now being used in thin-seam mining, there are certain restrictions imposed by decreasing seam height and adverse roof conditions which make this equipment impractical to operate. It was in those areas where mobile operations were impractical that an urgent need was apparent for some other form of mechanization.

Experimental Continuous Mining

A constant search was and is maintained to improve the mining of low coal. In 1956 this search led to information concerning a newly developed thin-seam continuous miner. In June, 1956, a mine superintendent and engineering representatives visited the West Virginia plant where these machines are built. This visit was for the purpose of examining the machine in various stages of assembly and included visits underground at two different mines where the continuous miners were observed in actual operation. Observations made on this trip were very encouraging with respect to thin-seam mining problems and it was decided to procure one for experimental purposes as soon as possible. This experimental continuous miner would be used to evaluate its performance against other low-vein mining methods.

A brief description of the machine, its method of operation and application to our operation follows.

An auger-type continuous miner represents the latest operating development currently utilized in thin seam coal production. The miner consists of a shortwall cutting machine chassis with two 24-in bit-studded augers mounted on the front end. At the rear of the machine is a gooseneck elevator which is connected to a bridge-type chain conveyor. This conveyor terminates at a slide which straddles the room conveyor. The swivel connections at the slide and gooseneck provide flexibility in movement of the machine. The height of the machine and bridge conveyor is 25 in while the overall length, including the bridge conveyor, is 42 ft 9 in from the leading edge of the auger to the swivel connection for the slide on the conveyor.

The chassis, reduction gearing, jacks, and augers are mounted on a base which rests on rails on a bed-plate. A 25-in chain conveyor, powered by a 5-hp motor extends from the throat at the front end of the bed-plate to the rear of the chassis and up a gooseneck elevator. The controls are hydraulic and are located at the rear of the machine.

The two augers mounted on the front of the machine are 41 in long. Each auger has 10 bits located in the front cutting edge of the auger scroll and 22 bits equally spaced along the auger screw edge. The augers are driven through reduction gearing connected to the extended shaft of the 50-hp motor, and rotate in opposite directions.

Independent vertical placement of the two augers is controlled by hydraulic jacks. Hydraulically controlled

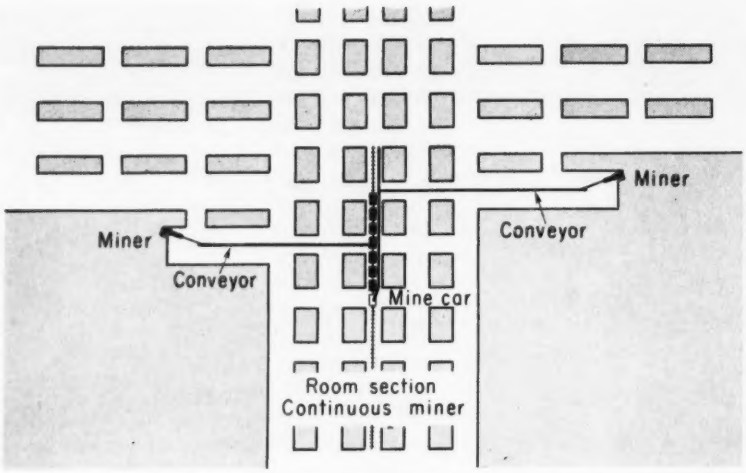


FIG. 2–ROOM PLAN includes driving rooms off both sides of five-heading entry with continuous miner and conveyor. Conveyors feed to mine cars. Rooms are worked on retreat and no pillars will be extracted.

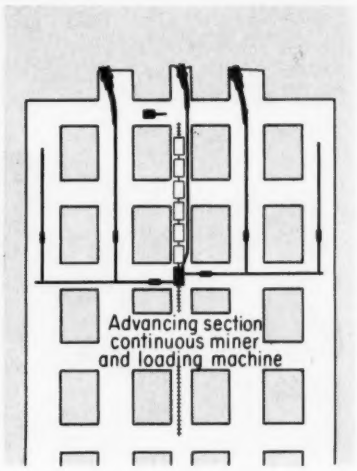


FIG. 3–TWO MINERS and loader are used where rock is taken in five-heading entry. Loader remains in middle heading.

tilting shoes, at the rear end of the machine, provide for auger adjustment to compensate for roof and bottom variations. Two cleanup screws, one of which can be seen below the raised main auger, are each 14 in long and eight in in diameter. They convey the augered coal to the throat of the machine where it is picked up by a chain conveyor which runs between the bed-plate and the machine chassis.

The machine is operated in the same manner as a shortwall mining machine. It is "sumped in" about 3 ft at either rib line and maneuvered across the face through proper positioning of the jacks and ropes attached to the power drums. The machine cuts in either direction and is "sumped" with the elevated auger leading the trailing auger which is at the bottom of the seam. As the machine cuts across the face the coal is carried by the augers to the machine conveyor throat. The cleanup screws assist in moving the coal toward the conveyor. Loose coal from the following side of the machine is shoveled into the cleanup screws by one of the helpers. The operational similarity of the continuous miner to a shortwall mining machine has assisted in the rapid training of proficient operators in a minimum of time.

At this transfer point the coal passes from the gooseneck elevator at the rear of the miner, to a chain-flight bridge conveyor. The swivel connection at this point permits flexibility for movement of the machine.

FIG. 4–ROOF SUPPORT PLAN combines roof bolts and wood timbers on 4-ft centers for easy maneuvering of miner.

From the bridge conveyor the coal passes onto a shaking conveyor. The bridge conveyor is also powered by a 5-hp motor. There is a swivel connection at this point also. This connection provides additional flexibility for machine maneuverability.

The coal is conveyed to the loading point where it discharges into drop bottom mine cars which transport it to the underground dumping station. The coal dust is allayed at all loading points with spray systems above the mine car.

Room and Entry Work

Figure 2 is a schematic portraying the miners operating in a room section. Rooms are being driven by miners on both right and left off the five-place entry. The heading or center place is the tracked entry. Rooms are being worked on the retreat and no pillars will be extracted.

The heading or track place of a five-place advancing section shown in Fig. 3 is worked with a low-vein mobile loader. The mobile loader is used in the heading since the miners will not handle the crushed rock. The air courses are worked with one miner driving the two air courses and all crosscuts on each side of the heading. The miners work an air course for the distance between crosscuts, drive the crosscut and then move to the adjoining air course and repeat the cycle.

Future plans call for installing experimental extensible room belt conveyors which will feed the coal mined by seven continuous miners onto the main belt as shown in Fig. 1. The miners will drive seven entries through to the adjacent entry then turn and drive seven paralleling entries. The placement of the main belt is such that moving it will not be required except on every other set of entries.

One of the roof support plans is shown in Fig. 4. Note that the roof bolts are shown as squares and the wood timbers are shown as circles. This combination of roof bolting and wood timbering has made possible the easy maneuverability of the continuous miner. It provides maximum protection for the workmen with a

minimum of timber removing and resetting.

Miner Experience

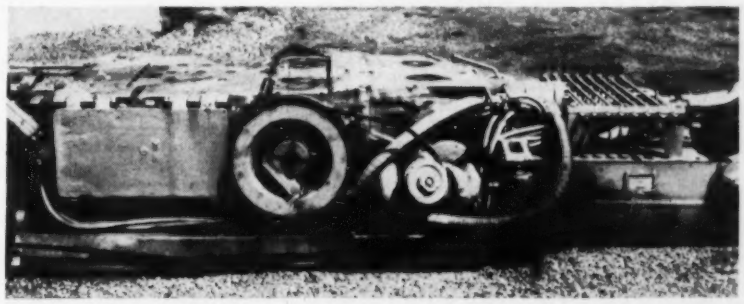
The first auger-type continuous miner was delivered to TCI on Jan. 16, 1957, and was put into operation almost immediately. This miner was used to replace two room set-ups on a section that was working four rooms by hand loading coal onto conveyors. In March, 1957, the second miner was delivered and this machine was placed on the same operating section with the first. It replaced the two remaining hand loading room crews to make up the first complete continuous miner section. Inasmuch as there were no spare machines at this time the mining plan reverted to hand loading the conveyors when one of these machines was down for any major repair or maintenance. Of course this created a problem since the manpower requirements for a hand loading operation are entirely different from a continuous miner operation.

To say that the first two machines met original expectations after a few months operation would be in error, but we were learning and even though initially plagued with both operational and mechanical difficulties a great potential was seen for this type equipment. Plans had been made and orders had been placed for more of the continuous mining machines.

Training the Men

Looking forward to the arrival of more machines the need was felt for a training team to train supervisory, operating and maintenance personnel in the operation and maintenance of these machines. In September, 1957, a training team consisting of two industrial engineers and an operating supervisor was formed. This training team underwent a special two week instructional course. The various phases of instruction for this team were handled by the supervisor of training, general superintendent's staff members and mine supervisors who had had prior experience with the continuous miners. It included such subjects as job instruction training, principles of miner operation, how to make job breakdowns, job relations training, maintenance procedures, observation of the miner in operation, and other related subjects. Special safety meeting outlines were prepared by the mine safety inspector and were used by the training team to conduct safety meetings at the beginning of each training shift. This team has been a tremendous asset in the transition to continuous mining operations.

TWO AUGERS on front end of machine are 41 in long. Each auger has 10 bits on front cutting edge and 22 equally spaced on edge of scroll.



CHASSIS, reduction gearing, jacks and augers are mounted on a base.

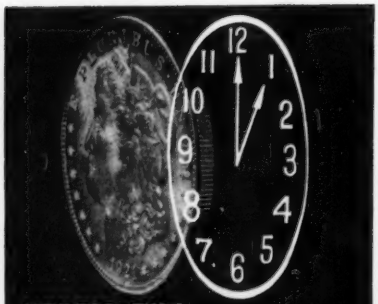
In October, 1957, the third and fourth continuous miners were received. During that same month they were put in operation on a section working rooms in the same manner as the first continuous mining section. This second section commenced operations with less difficulty than the previous section.

During the next four months eight additional continuous miners were obtained, bringing the total to 12. In addition to using the miners on room work they are now used in advance work to drive air courses. When advance work was first started, continuous miners were used to drive a heading with one air course on each side. It soon became apparent that the duckbill in the heading could not keep up with the miners and plans were changed to drive two air courses on each side of the heading. Later, the duckbill was replaced by a mobile loader in the heading further to improve the operation.

Safety Improved

At TCI "Safety First" is not just a slogan. It is a foremost consideration in anything that is done or planned to be done. There can be no plans made for production until safe working conditions have been assured for the employees. The continuous miners fit into these plans in that one of the most important advantages of continuous miner operation is provision for a safer working place. Fewer men are exposed for a shorter time to the hazards of face operations. The continuous miner program has not been in operation for a sufficient period of time to properly evaluate the effect. However, experience with the safety aspects of continuous thin seam mining has been very encouraging so far.

The absence of blasting has helped



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Comparative Lining Cost Chart†

	MATERIAL COST	LABOR COST	TOTAL COST	SAVINGS
Build two new funnels for magnetite boxes out of ¾" steel	$35.00	$175.00	$210.00	
Use Linco Regular Lining on worn sections of old funnels* over expanded metal	$30.00	$ 25.00	$ 55.00	$155.00
Use Linco Regular Lining over RL-50 Bond	$26.00	$ 5.00	$ 31.00	$179.00

*The old funnels lined with Linco Regular Lining will outwear the new funnels.

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tremendously in roof control. The characteristics of the roof are such that continual difficulty was experienced in controlling it as long as blasting was done. In contrast, even though approximately the same roof support pattern is used with the continuous miner, occasions are rare indeed when roof control problems interfere with production. This was evident immediately when the first machine was placed in operation adjacent to a room where the face was being blasted. One had only to move through a crosscut from one room to the other to observe the indisputable evidence of this fact. Elimination of this practice through the use of continuous mining machines has produced improvements in both safety and cost.

As with most other mining companies one of the major concerns in coal mining is roof control. A combination of roof bolting and wood timbering has been very successful in areas that are mined continuously. The roof bolts allow for maneuverability of the machine without the constant necessity of resetting wood timbers, while the wood props set according to plan along the ribs of the working place give a safe and workable timbering plan.

Continuous Miner Results

Production figures for continuous miner sections have been very encouraging. Comparing run-of-mine production on hand loaded room sections with a continuous miner belt section on room work, production increased from 8.75 to 21.84 tons per sectional manshift or 150%. On advance work the same trend continued with production increasing from 8.56 to 16.56 tons per sectional manshift, which is an increase of 94% over the old system.

By comparing present standard production rate curves it has been concluded that for room work the continuous miners have the advantage over any present known methods of mining in seams where they can be utilized. The restricting factors that govern use of the miners are the amount of rock in the seam and the miners' maximum height limitations. This at present is a somewhat theoretical assumption which has not yet been substantiated in actual practice.

Future Plans

Work with thin seam continuous mining is still far from completed. There remains a great deal to be done toward improving current methods of operation with respect to reducing downtime and costs and increasing productivity. Up to the present time continuous miners have been adapted to existing mining methods and operated without the purchase of any special auxiliary equipment. It is already evident that with improvements in auxiliary equipment the productive capacity of these machines can be more fully utilized. the coal from the miner to the mine One problem is the transportation of car loading point. Future plans are to purchase experimental extensible room belt conveyors which will alleviate this problem. These room belt conveyors will be installed in conjuction with a main belt and seven continuous miners. This should increase the productive time for the machines by eliminating the time now spent waiting to have mine cars "swapped out."

It is an obvious fact that mining a thin seam of coal, on a competitive basis, is more difficult than mining a thick coal seam. And the more rapid mechanization of thick seam mining has accentuated this competitive difficulty. Consequently, the investment in thin-seam continuous miners was a necessary step to increase production by taking full advantage of the limited face productive time. Through the coordinated efforts of men and machines these continuous miners, along with other cost reducing innovations, have brought TCI a long way toward solving the problem of mining thin seam coal.

By no means the least important achievement gained by converting to continuous mining has been the minimizing of two hazards inherent in former practice: numerous men in the danger zone at the working face and broken roof resulting from blasting. The number of men working directly at the face and time of face exposure has been greatly reduced. There is no need to elaborate on the increased safety gained by the elimination of blasting. In addition to the humanitarian aspects of safety, there is a definite economic gain in the prevention of accidents: any way you look at it, the use of continuous mining in thin seams is paying off.

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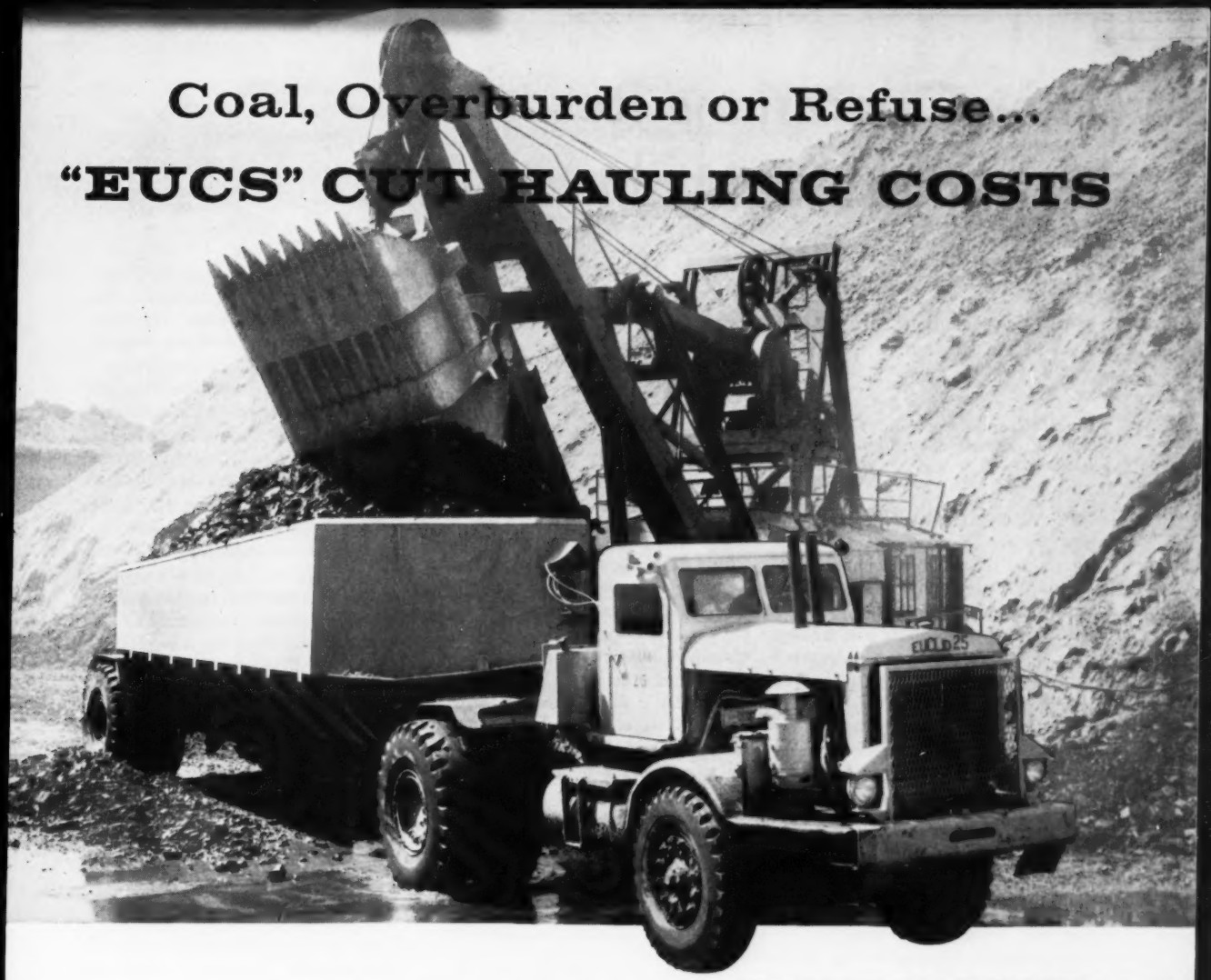

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How Operations Research Can Improve Mining Results

Operations research techniques and how they can be applied to coal mining activities for higher efficiency and lower costs.

Ernest Koenigsberg
Touche, Ross, Bailey & Smart, San Francisco

NOT ALL IMPROVEMENTS in coal mining brought about by research are related to machinery, mechanization or safety. Some of the latest developments are concerned with different aspects of the mining operation treated as an integrated system. A relatively new technique called "Operations Research" has recently been applied with startling results to several problems of this kind in conventional mechanized deep mining. "Operations Research," incidentally, has been called "the application of scientific methods to the solution of problems in business, commerce and industry." Many techniques once limited to the fundamental sciences are now being used as tools in day-to-day profit-making operations. In the following examples the applications of mathematical model techniques and computer-simulation studies will be analyzed.

Increasing Section Output

The first step in increasing section output is representing the situation in terms of a mathematical model—not a physical reproduction of the mine on a convenient scale but a true representation, in mathematical terms, of the operation being studied.

Essentially the process under consideration is one in which a group of specialized machines and their operators work a number of faces in succession, following each other around in a set sequence. Ideally, each machine moves to the next face when it has completed its job in the present one. In fact, of course, no machine can move to the next face until that face is "free"; i.e., no longer occupied by the previous machine in the cycle.

Now, it might be argued that there would never be any delays in moving from one face to the next if all machines in the cycle were to work at the same rate and take the same time over each of their jobs. Even this state of affairs, known as a "balanced system," can and does, however, lead to waiting time. What is called the same rate for each job is in reality only the same average rate. There will always be variations from this average rate and, however small the variations, the mathematical theory shows that delays will mount up. This will soon result in long waits for some machines while the preceding machines complete their jobs.

Any system involving a number of machines with different functions seldom is in balance. Delays arise out of two factors. First, there is the usual variation that occurs in every job. Fig. 1 illustrates, for example, how the cutting time in a particular mine can vary. Then there are the differences between the average rates of the different machines. The machine following that taking the longest average time to complete its job at a face is in a similar position to the driver of a new automobile behind a horse and buggy where no overtaking is allowed. This analogy cannot be pushed (or driven!) too far because the machines we are studying are in a continuous cycle, so that, depending on the interaction of the two types of delay, the waiting times may pile up or, contrariwise, offset each other as the machines travel in their circle.

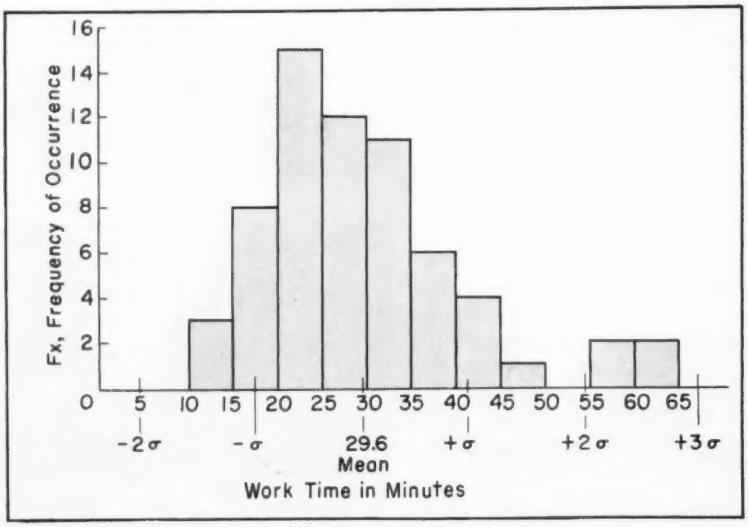

FIG. 1—HOW CUTTING TIME can vary in a typical mine.

Queue-Theory Analysis

In any event waiting time on the part of any machine is unprofitable from the point of view of coal-winning. Waiting in line is a common phenomenon in daily life and in many other industries too, and a mathematical technique, called "Queue Theory," was developed by operations research analysts many years ago to formulate and solve the problems associated with delays of this kind. Having obtained the right mathematical model of the deep-mining operation, the next step is to apply queue theory to show how

the delays of all machines, taken as one production unit, can be minimized. If this can be done the maximum possible output will be obtained from each section.

There may, of course, be obstacles to putting the theoretical solution into practice. The original calculation does not take into account such factors as cost, safety, personnel, etc., but once the ideal answer has been formulated, cost and other factors may be brought in to reach a compromise solution that increases profits appreciably.

To understand the mathematical model used to represent the operation being studied, we must once more consider the essentials of the system. A number of machines, M, is lining or queueing up in a fixed order (no overtaking) to mine N coal faces. The order in line is fixed, since the jobs must be performed in sequence.

The machines actually move around the faces but it could be considered that the faces also present themselves to each machine in a cycle. Thus, say, the cutter will have a series or line or queue of N faces always coming around for the same service in the same order. This cyclic pattern leads to mathematical formulation of the problem in terms which are actually the reverse of the physical terms. The queue-theory model is regarded as one in which a certain number of machines (M) stay put while a closed loop of N faces comes around for service at each machine in turn.

The time needed by a particular machine to "service" each face, as already noted, varies. In the mathematical treatment, service time also is taken to include travel time between one face and another, and any breakdowns that may occur (though not, of course, out-of-service time due to regular overhaul and maintenance). When served at the last, or *Mth*, machine, the face rejoins the queue at Machine 1. Since the queue of faces has this cyclic quality it can be considered as "beginning" at any stage and ending at the stage preceding that chosen as the "first."

Queue-Theory Application

Among the more important answers sought in the mathematical application of queue theory to this model are:

1. The output (O) of the entire system, regarded as one manufacturing unit.

2. The average cycle time (T) to complete service to all M stages.

3. The utilization factor (U), defined as the ratio of working time to total time of the entire production unit, and of each individual equipment unit (U_1, U_2, etc., through U_M).

These quantities are obtained by using numbers obtained on the job and substituting them into the equations. Agreement between calculated and actual results in the example under discussion proved the validity of the mathematical treatment. It next became possible to study the effects of modifications to the existing equipment theoretically by introducing these modifications into the equations. Finally, the most practical projection of the theoretically ideal solution could be achieved.

Although it has already been stated that the system was not a "balanced" one, the case of "balanced machines" was first calculated as a starting point. The formulas which connect the most important quantities are:

$$(1) \quad T = \left[M + \frac{N(N-1)}{(N+M+1)}\right]t$$

$$(2) \quad 0 = \frac{H}{t}\left[\frac{N}{N+M-1}\right]t, \text{ or } \frac{HU}{t},$$

where t = mean service time for each stage (in the "balanced system" $t_1 = t_2$ through $t_M = t$),

H = number of hours per day or per shift (depending on the output figure required) and,

U = utilization factor of the system (defined as the ratio of working time to total available time)

Table I gives numerical values for these and other quantities for numbers of faces (N) between 3 and 21, number of machines (M) between 3 and 6. From Equation (2) the total output (O) of the system is directly related to the utilization factor (U). The table shows that, for any one number of machines (M) the utilization factor increases with the number of faces being worked. In practice, of course, there are often limitations to increasing the number of faces (N) in this way, as will be discussed later.

The mean number of faces waiting at each stage, w, also is given in Table I. This quantity can be an important practical factor if space is limited, as may easily happen if the number of faces (N) is small. In conventional mining, however, the number of faces is usually greater than the number of machines (M). The main value of the table is that it enables a combination of N and M to be selected (wherever such a choice is physically possible) that gives the highest value of the utilization factor (U) and thus of total output (O).

Table I—Results for 3- to 6-Machine Systems for Various Numbers of Customers

N, number of faces in system.
n, Mean number of faces at each stage (waiting to be serviced).
w, Mean number of faces waiting at each stage.
T, time for a unit to complete M stages.
U, utilization factor (fraction of time each stage is operating).
S, average number of customers being served in the system.

N	n	w	T	U=1−D	S
	M=3				
3	1.00	0.4	4.2	0.6	1.8
4	1.33	0.67	5.0	0.67	2.0
5	1.67	0.95	5.85	0.71	2.13
6	2.00	1.25	6.75	0.75	2.25
11	3.67	2.83	11.49	0.85	2.55
16	5.33	4.45	16.35	0.89	2.67
21	7.00	6.35	22.05	0.91	2.73
	M=4				
3	0.75	0.25	5.0	0.5	2.00
4	1.00	0.43	5.72	0.571	2.28
5	1.25	0.625	6.50	0.625	2.50
6	1.50	0.83	7.32	0.67	2.66
10	2.50	1.73	10.92	0.77	3.08
11	2.75	1.97	11.88	0.787	3.13
15	3.75	2.91	15.64	0.835	3.34
16	4.00	3.15	16.60	0.845	3.38
20	5.00	4.11	20.44	0.870	3.48
21	5.25	4.37	21.48	0.875	3.50
	M=5				
3	0.6	0.17	5.85	0.43	2.15
4	0.8	0.30	6.50	0.50	2.50
5	1.0	0.445	7.22	0.555	2.775
6	1.2	0.60	8.00	0.60	3.00
9	1.8	1.10	10.50	0.70	3.50
10	2.0	1.28	11.40	0.72	3.60
11	2.2	1.47	12.35	0.73	3.65
15	3.0	2.21	16.05	0.79	3.95
16	3.2	2.40	17.00	0.80	4.00
20	4.0	3.16	20.80	0.84	4.20
21	4.2	3.36	21.80	0.84+	....
	M=6				
3	0.5	0.125	6.75	0.375	2.25
4	0.667	0.223	7.34	0.444	2.66
5	0.833	0.333	8.00	0.500	3.00
6	1.0	0.455	8.73	0.545	3.27
10	1.667	1.00	12.00	0.67	4.00
11	1.833	1.146	12.86	0.687	4.12
15	2.50	1.750	16.50	0.750	4.50
16	2.667	1.905	17.45	0.762	4.57
20	3.333	2.533	21.20	0.800	4.80
21	3.500	2.692	22.10	0.808	4.85

Various-Rated Machines

Where all the machines have different average service times it still is possible to solve the mathematical equations derived from the model. Actual operating data may be used in the calculations to give theoretical values for the outputs obtained with

Table II—Effect of Varying the Number of Places on Productivity, Four-Step Cycle

	Time per Face, Min	Service Rate, Faces per Hr	% Working Time or Utilization N=5	N=6	N=7
Loading	25.24	2.3772	67.0	71.3	74.3
Cutting	24.50	2.4490	65.0	69.1	72.5
Bolting	23.83	2.5178	63.1	67.2	70.2
Shooting	20.29	2.9571	53.8	57.2	59.9
Calculated output, tons per hr			45.8	49.0	50.6
Actual output, tons per hr			....	48.5	....

Table III—Effect of Varying the Number of Places on Productivity, Five-Step Cycle

	Time per Face, Min	Service Rate, Faces per Hr	% Working Time or Utilization N=6	N=7	N=9
Shooting	28.1	2.135	72.3	76.4	84.2
Loading	25.6	2.344	65.9	69.6	76.8
Cutting	23.0	2.609	59.2	62.5	69.0
Drilling	19.8	3.030	51.0	53.8	59.4
Bolting	17.4	3.448	44.8	47.3	52.2
Calculated output, tons per hr			77.25	81.54	90.04
Actual output, tons per hr			80.00	....	....

different numbers of faces (N). As an example, consider a 58-in seam of metallurgical coal, six working faces ($N = 6$) per section and a four-step cycle with cutting and drilling a single operation.

Each face is cut 18 ft wide and 8 ft deep, and the average yield per cut is 28.8 tons. Table II shows the standard times, service rates and utilization factors for each stage with 5, 6 and 7 faces. In practice the number of faces (N) is 6, and the actual output is 48.5 tph. Since the theoretically derived value for this output (O) is 49.0 tph, the validity of the calculations would seem to be proved quite adequately.

To make doubly sure, another calculation was made using data for a 7- to 12-ft seam, six faces and a five-step cycle ($M = 5$), since considerably more drilling is required than in the mine used for the last example. Average cut yield is about 50 tons. Table III gives the calculated results for 6, 7 and 9 face setups. Once again, the close agreement between the theoretical output (77.25 tph) and that actually achieved for 6 faces (80.0 tph) shows the validity and usefulness of the model employed.

Partial Unbalance

The balanced system, in which all machines operate at the same average rate, and the opposite with all at different rates represent the two extremes. Between them two or more of the machines may have the same operating rate. When the calculation based on the mathematical model is completed, the general trend of the results is the same for all three situations and can be summarized as follows: The output increases as the number of faces worked (N) increases *but* the output is ultimately limited by the operating rate of the slowest machine in the cycle; the rate of increase of output decreases as N increases. We can therefore consider the marginal gain for the last face added.

Using the data on which the results in Table III were based, but assuming first complete and then partial unbalance in machine capacities, new output values can be calculated. Suppose that all operations are performed at the rate of the slowest machine (loading in Table II), then from Table I we have $U=0.67$ for four machines and six faces, so that Equation (2) gives us an output of 1.586 faces or 45.65 tph.

Now let us assume that times for loading, cutting and bolting are all the same and are equal to that of the slowest machine (loading) but that shooting is done 25% faster. The output is then calculated to be 48.0 tph. Results are summarized in Table IV.

In going from a balanced to a partially unbalanced system, which involves speeding up the operating rate of one machine, the output is increased from 45.65 to 48.0 tph. Under certain circumstances, therefore, an unbalanced system can yield higher production than a balanced one. This principle, which may at first sound almost heretical, must, of course, be applied with care, taking into account the actual operating rates, or rather the differences between operating rates, of the machines in the system. Where one machine is faster than all the others, which are balanced among themselves, output will be lost if that one is made to slow down in a misguided effort to achieve a completely balanced system.

Slow-Unit Situations

It now becomes possible to solve the opposite problem, where one machine is a good deal slower than all the others, whether they are all working at the same rate or not. Here, we shall introduce the concept of "doubling up" on the slowest machine, since this would be the obvious approach to increasing the output of the system.

The basic equations derived from the mathematical model are amended slightly to include parallel service (already well known in queue theory) at one stage. This involves the addition of another probability at the doubled stage. Everywhere else there are only two conditions: the machine is either working or not working. For the stage with two units for the same operation three probabilities exist: both machines, either machine or neither machine may be working.

Using the data which led to the results in Table III, the effects of doubling up on the shooting operation only have been calculated and are given in Table V for both 6- and 9-face setups. When $N=6$, the output is increased from 77.25 to 85.50 tph, an increase of 8.25. A closer look at the percent working time or percent utilization also is of interest. The doubling up has had the effect of making two shooting crews wait 60% of their time. This idling of men and their equipment might be considered unjustified, and yet the overall increase in output flowing from it may well be high enough to offset the extra costs (labor, capital equipment, etc.) involved in making the change.

General Considerations

As stated previously all the results presented so far show that the output of the system increases as the number of faces worked increases. This would be true as long as the operating rates of all stages are independent

Table IV—Outputs for Balanced, Partially Unbalanced and Completely Unbalanced Loading-Unit Setups

	Service Rates (Faces per Hour)				Calculated Output (Tons per Hr)
	Loading	Cutting	Bolting	Shooting	
Complete balance..	2.377	2.377	2.377	2.377	45.65
Partial balance....	2.377	2.377	2.377	2.957	48.00
Complete unbalance	2.377	2.449	2.517	2.957	49.00

Table V—How Doubling up on Slowest Job (Shooting) Affects Productivity Shown in Table III

	Time per Face, Min	Service Rate, Faces per Hr	% Working Time or Utilization	
			N=6	N=9
Shooting.....	28.1	2.135	40.0	45.9
Loading.....	25.6	2.344	72.9	83.6
Cutting.....	23.0	2.609	65.5	75.1
Drilling.....	19.8	3.030	56.4	64.6
Bolting.....	17.4	3.448	49.6	56.8
Total output, tons per hr.....			85.50	97.95

of the number of stages worked, but we stipulated that operating rates would include transit, or "tramming," times. In practice, therefore, the average operating rate for a machine will increase slightly with each extra face worked, the distance between the first and last faces lengthening each time.

The effect of the greater distances involved will be particularly noticeable in service to the loader since the shuttle cars would travel longer distances to the loading point, but the widening of the working panel may have other effects. For example, it might become necessary to provide extra nipping stations, thus increasing the need for "maneuvering" and again decreasing the average service rates.

The question of costs is, of course, one of the most important to be considered before any of the above theoretical results can be put into practice. The extra nipping stations already mentioned may have to be supplemented by additional track for loading mine cars and (in mines working a low seam) extra shooting to create additional transfer stations. Even if the working area was not increased, but doubling up on slow stages is adopted instead, the cost of the additional equipment and manpower must be weighed against the value of the expected increase in output.

Equipment Maintenance

The queue-theory approach can also be used to solve many other mining problems. For example, the "equipment in use-overhaul-spare parts inventory" aspect of operations is susceptible to the same type of analysis. Lack of a working unit to replace that entering the overhaul cycle is costly. Indeed, in an integrated mining operation, the real cost of an equipment failure is greatly increased, since the absence of one machine may mean the loss of output from an entire section unless a replacement is immediately available.

To provide an excessive number of spare machines would, however, tie up too much capital. The purpose of an operations-research study, therefore, would be to determine the proper number of each type of unit to have on hand, taking into account breakdown frequencies, overhaul schedules, and so on.

Improving Haulage

A mine haulage system can be considered as a series of cyclic operations impinging on one another at various points. From the face the coal travels by shuttle car to a transfer station some distance away, passing through a changing point on the way when more than one car is used. From the transfer stations mine cars or conveyor belts take the coal to the tipple. Each phase of this operation is a cycle, with loaded cars (or belt) moving coal away from the face and eventually traveling back empty. The first of these cyclic operations, that of the shuttle car, is illustrated in Fig. 2 for 2- and 3-car systems, although in practice 1, 2 or 3 shuttle cars could be used, each operating along its own "runway" from change point to transfer point.

As a good approximation, the mathematical treatment of this system follows the type of queue-theory analysis used for determining the output of a section. Stage 1 of the operation includes the travel time from change point to loader, loading time at the face, and the travel time back from the loader to the change point. Stage 2 which, as already stated, can have 1, 2 or 3 parallel operations, includes the travel time (loaded) from the change point to transfer station, the dumping time, and the travel time (empty) from the transfer to the change point. This model is reasonable since each shuttle car has its own runway, and any interference between shuttle cars occurs only in the loading stage (between the change point and the loader).

For example, values for the loading, dumping and travel times, as determined by industrial engineers, are given in Table VI. Using the mathematics of cyclic queues already developed for dealing with face operations, the model approach permits the evaluation of the work times for the loading stage in terms of the number of shuttle cars and the output of the section, i.e., the quantity of coal to be carried in a given time.

The results are given in Table VI for 7-ton mine cars, 4-ton mine cars and belt haulage. Since the loading stage is the slowest the changes in dumping time for the three different means of transportation have relatively little effect on total loading time. The effects of adding shuttle cars are, however, striking. The total loading time is reduced by about 20 min (approximately 33%) in going from a system with only a single car to one with two.

Adding a third car reduces the total loading time by another 5 to 6 min. Further additions will not reduce this quantity by more than 1.5 to 2 min. As has already been said, it must be remembered that adding shuttle cars may require other changes. The cost of the operation may not only be increased by the cost and maintenance of the extra shuttle car itself, but additional transfer stations may have to be shot out, particularly when working thin seams.

The net gain in productivity derived from better loading can only be evaluated in terms of its effect on the face-operations cycle (already described in detail). To make such

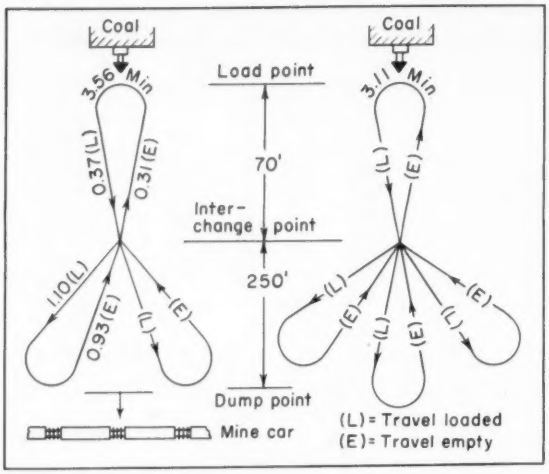

FIG. 2–SYMBOLIC MODELS of 2- and 3-car shuttle-car systems, with loading and travel times. Dumping times for different mine cars and conveyors are listed in Table VI.

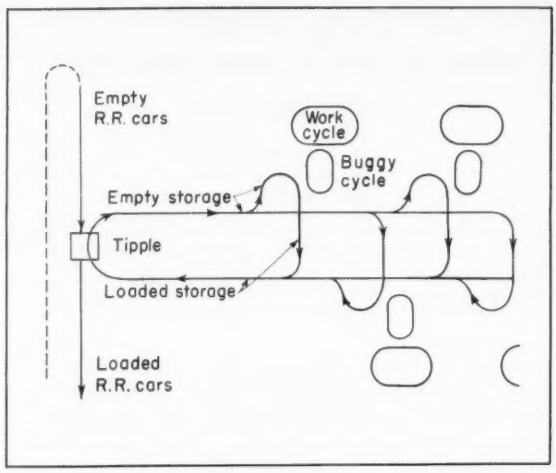

FIG. 3–SYMBOLIC MODEL of a mine-haulage system viewed as a combination of cyclic transportation patterns. The shuttle-car cycle, for example, is similar to those shown in Fig. 2.

Table VI—Effect of Varying the Number of Shuttle Cars on Productivity

	Work Time, Min	Work Rate, Loads per Hr	1 Shuttle Car % Utilization	1 Shuttle Car Time for 50 Tons, Min	2 Shuttle Cars % Utilization	2 Shuttle Cars Time for 50 Tons, Min	3 Shuttle Cars % Utilization	3 Shuttle Cars Time for 50 Tons, Min
7-Ton Mine Cars:								
Loading	4.24	14.15	53.3	....	83.6	....	95.6	....
Dumping, each car	3.70	16.20	46.6	63.7	36.1	41.0	27.9	35.5
4-Ton Mine Cars:								
Loading	4.24	14.15	52.8	....	80.5	....	93.2	....
Dumping	4.03	14.90	50.1	64.2	38.4	42.2	29.6	36.4
Belt:								
Loading	4.24	14.15	54.5	....	84.1	....	96.5	....
Dumping	3.49	17.20	45.0	62.0	34.7	40.3	26.4	35.0

Loading time in minutes equals travel time loaded (0.37 min), plus travel loaded (0.31), plus dumping (3.56).

Dumping time in minutes equals travel loaded (1.10 min), plus travel empty (0.93), plus dumping times as follows: 9-ton car, 1.83 min; 7-ton car, 1.67; 4-ton car, 2.00; belt, 1.46.

an evaluation possible an analysis of the section output as a function of the number of shuttle buggies has been made for a hypothetical 6-face 5-machine section. Work times for each stage are given in the first two columns of Table VII. It is seen that adding the second shuttle car increases production 10.87 tph while the third car produces only an additional 2.50 tph. Once again, the same considerations apply as in "doubling up" on the shooting operation (Table V).

Haulage

The main line of a mine is, in a sense, the heart of haulage and communications. One can therefore begin a discussion of mainline haulage by considering coal mining as an industry that transports and transfers material rather than the more conventional view of an industry devoted to winning a raw material. The operational problems are then concerned with the ability to receive coal from the sections and meet the delivery demands of the tipple.

Fig. 3 is an illustration of mining operations from the perspective of the haulage system. Mining operations are viewed as consisting of transport cycles (the moving of coal) and transfer cycles (from one haulage agent to another, as, for example, from shuttle cars at the section dump or transfer point).

Apart from such considerations as safety, delivery of supplies, etc., the criteria by which the whole system is judged will be the cost of the haulage systems (say, per ton of output) and ability to handle the output of the mine. Each transport and transfer stage can be characterized by a number of measureable limits, such as, the number of units operating, the time for the operation, the volume of coal handled per operation, etc.

Any model and subsequent analysis of haulage operations should therefore be capable of predicting the output of the system (and its cost) within these limits. As before, the analysis should also permit the evaluation of the effects of changes and modifications on the cost and the output.

A typical mainline track-haulage system is shown schematically in Fig. 4. There are seven operating sections, track being shared as shown. The system operates with about 450 7-ton mine cars and 8 locomotives. One locomotive is assigned to each section and operates between the loading point and the sidetracks. The eighth is in mainline service between the sidetracks and the tipple.

There is sufficient track at the tipple for about 150 mine cars, while about 110 cars can be held on the sidetracks. Fig. 5 is a symbolic model of the system, showing the trip-loading time and the number of cars per trip for each section. Table VIII gives the travel times. Although the schematic layout does not provide for any interference that may be due to the sharing

Table VII—Section Output as a Function of Shuttle-Car Number, Six Faces, Five-Step Cycle

	Time per Face, Min	Service Rate, Faces per Hr	% Working Time or Utilization 1 Car	2 Cars	3 Cars
Shooting	37.5	1.6	56.7	69.7	73.5
Cutting	30.0	2.0	45.4	56.4	58.8
Drilling	25.0	2.4	37.8	47.0	49.0
Bolting	20.0	3.0	30.3	37.6	39.2
Loading, 1 car	60.0	1.0	90.9	....	....
2 cars	40.0	1.5	....	75.3	....
3 cars	35.0	1.714	....	....	68.6
Output, tons per hr			45.46	56.34	58.84

Table VIII—Travel Times for Systems Shown in Fig. 5

Sec.	Travel Empty, Min	Travel Loaded, Min
1	18	19
2	15	16
3	8	9
4	9	11
5	12	12
6	8	9
7	11	12
Dump shuttle	9	10

of track, the travel times in the table do include the interference.

The mainline locomotive picks up 50 loaded cars at the sidetrack and delivers them to the tipple. The main liner then returns to the sidetrack area with 50 empty cars which now become available for any section.

Because of the size of the system and the complexity of interaction of the cycles (different for mine cars and locomotives), this haulage system is more complicated than those discussed previously. Not only that, there is a fairly large number of different ways in which the system may function. Locomotives, for example, might be pooled rather than assigned. Such a setup might prove less costly under some circumstances since fewer locomotives may be required. Locomotives may return to the section immediately after dropping their loads at the sidetrack or may be used for switching purposes before returning.

An alternative method of operation might be for locomotives to run on a schedule and pick up any loads available at their predetermined time of departure rather than wait for a full trip. Even the mainline service could perhaps operate on the same principle, picking up fewer than 50 cars if that many were not available on time. Other alternative modes of providing haulage service with a given amount of equipment also are possible. The mine operator is interested in the best service, where "best" has to be interpreted according to his individual needs as "the cheapest" or "that with maximum output" or some other similar criterion or a combination of them.

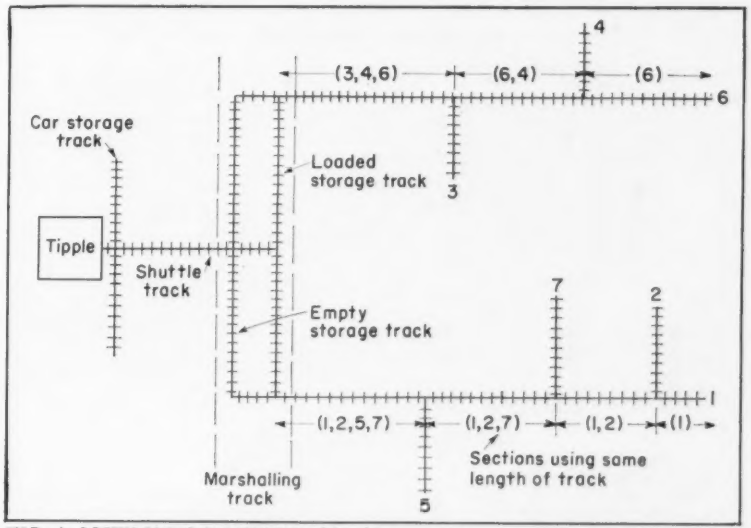

FIG. 4—SCHEMATIC DIAGRAM of haulage system serving seven working sections. Shared track is shown by the numbers. A single shuttle locomotive pulls to the dump.

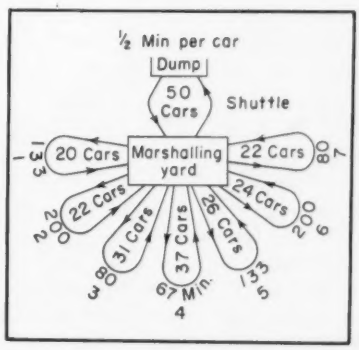

FIG. 5—SYMBOLIC MODEL of the haulage system shown in Fig. 4, with trip sizes and average loading time for trips shown. Travel times are listed in Table VIII.

Computer Simulation Study

So far the approach of analytic model formulation has not been used in the study of systems of this size and complexity, so that another technique has been employed. When analytical methods prove too cumbersome, difficult or time-consuming it usually is possible to obtain a greater understanding of the problem by setting up an analogue of the system, which can be manipulated by fairly straight-forward arithmetical methods, to provide a solution. The use of computers permits the time scale of the simulation to be compressed very considerably—several months of actual operation, for example, in a matter of hours.

A computer was programmed to simulate the system shown in Fig. 5, but with several modifications to allow some simplifications in the computer program. Since exact practical data on the distributions of loading, dumping and travel times were not available (only the average times being known), an exact solution was not possible at this time. The modifications do not, however, affect the model insofar as its illustrative and comparative purposes are concerned.

It was assumed that each section sent trips of 25 loaded cars to the

Table IX—Trip Characteristics for Computer Simulation

Sec.	Trip Size, No. Cars	Mean Travel Time, One Way, Min	Mean No. Cars Loaded in 5 Min	Mean No. Cars Loaded per Day, 90 5-Min Intervals
1	25	20	1.25	112.5
2	25	15	6.25	56.2
3	25	10	1.25	112.5
4	25	10	1.25	112.5
5	25	10	1.25	112.5
6	25	10	0.625	56.2
7	25	10	1.25	112.5
Dump shuttle	50	10	10*	900

*For dump shuttle mean number of cars dumped in 5 min at full dumping rate is listed in last column.

Table X—Travel Time, Loading and Dumping Rates, Computer Simulation

Travel Time				Loading				Dumping	
10-Min Mean Value		15-Min Mean Value	20-Min Mean Value	Mean Value 0.625 Cars per Interval		Mean Value 1.25 Cars per Interval		No. Cars in 5-Min Interval	Probability
m	P_m	P_m	P_m	m	P_m	m	P_m		
0	0.40	0	0	0	0.525	0	0.280	0	0
1	0.30	0	0	1	0.325	1	0.350	5	0.4
2	0.20	0.25	0	2	0.150	2	0.240	10	0.3
3	0.10	0.50	0.25			3	0.100	15	0.2
4		0.25	0.50			4	0.030	20	0.1
5			0.25						

m is number of 5-min intervals for one-way travel.
P_m is probability that m intervals are required to complete the travel.

Table XI—Results of Computer Simulation of Five Days of Single-Shift Operation

To Marshalling Yard From Sec.	Day 1	2	3	4	5	Average	Average Utilization
1	150	100	100	125	100	115	1.02
2	50	75	50	75	50	60	1.07
3	75	100	100	100	75	90	0.80
4	150	125	100	125	125	125	1.11
5	125	125	75	100	125	110	0.98
6	50	75	50	50	75	60	1.07
7	25	75	100	75	100	75	0.665
Total	625	675	575	650	650	635	100.5
Dumped	765	485	595	585	585	603	0.67

sidetrack and that locomotives return with 25 empty cars, the travel times being the same both ways to and from any given section. Table IX gives the mean values of the characteristics of the seven sections, while the distributions of travel times and loading and dumping rates are given in Table X. The following limitations were assumed:

1. The tipple holds 150 cars (empty and full).
2. The sidetrack holds 150 cars
3. Each section holds 50 cars (empty and full).

Given all these specifications, the computer examined the state of the entire system at intervals of 5 min. Cars were loaded, trips dispatched to and from the sidetrack area, cars were dumped at the tipple, empties became available for the return trip to the sidetrack, etc. The loading and dumping rates and travel times were determined for all haulage activity in the intervals between checks.

All changes were recorded and stored for future examination—in particular, the numbers of cars at the tipple and the sidetrack were preserved to obtain a record of their distributions. The total number of cars moved to the sidetrack area and the number dumped were also recorded to provide a measure of the output of the system.

Sample results for a simulated five shift-days of operation are listed in Table XI. These results were obtained by using the various distributions given in Table X as input data and are therefore more realistic than those which would have been obtained by the insertion of mean values alone. The use of average values would have given only average outputs for all sections, since any interference between them would not have been taken into account and thus would not have led to any meaningful results.

Study Results

The results of this simulation indicate that the seven section locomotives are more than adequate for the job they have to do. In fact, for this five-shift run, the system was operating at about 100% efficiency in terms of the rated output of the sections. The difference between the number of cars dumped at the tipple and the number sent to the sidetrack area is reflected in congestion at the sidetracks. Although the simulation assumed that the sidetracks hold 150 cars, there were nevertheless locomotive delays resulting from inadequate storage track. Such blockages, in fact, occurred in 29 out of the 450 intervals, but did not appear to cause any serious delays in loading since full output was achieved by most sections.

To test the effect of a smaller sidetrack, a second simulation was carried out for a capacity of 100 cars. The sidetracks were now fully loaded for 191 periods out of the total of 270 in a three-shift sample, or about 71% of the time. The output of the tipple was reduced to an average of 566 cars per day (instead of 603 cars as in the previous simulation), a reduction of 6.5%. The output of the section was reduced to an average of 592 cars per day (instead of the previous 635), a reduction of 5.8%.

More complete simulation studies should be carried out using as input the distributions of loading, travel times and dump times which have been obtained in actual practice. The simulation could also include the use of mine cars to haul supplies and account, in some way, for the design and layout of the tracks themselves. In many mines all the necessary data

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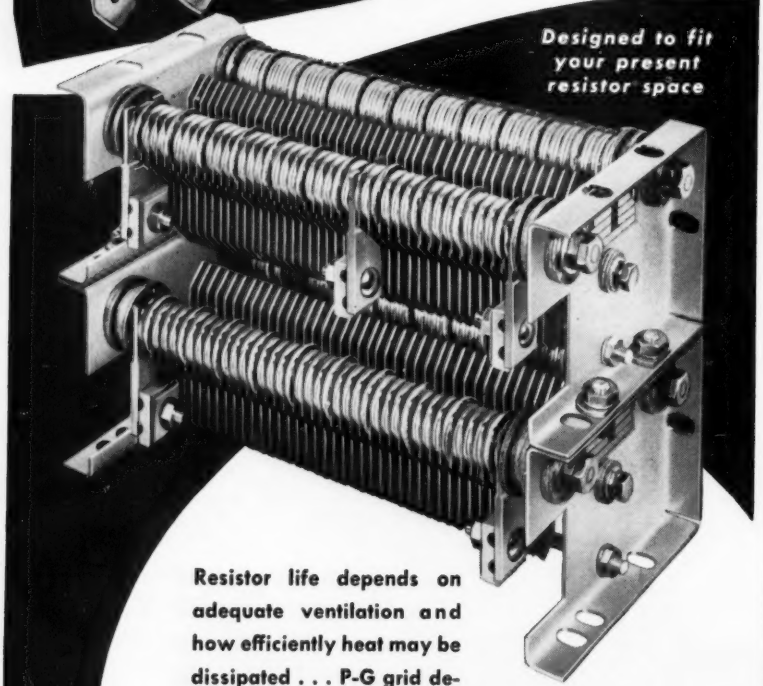

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P-G

The Nonbreakable Steel Grid Resistor

THE **POST-GLOVER** ELECTRIC COMPANY

OFFICE and FACTORY—Kenton Lands Road, Erlanger, Kentucky

MAILING ADDRESS—Box 709, Covington, Kentucky

are already available and only require analysis and synthesis. The "analysis of data-simulation-analysis of results" process will produce answers whose accuracy and feasibility depend on the effort expended. In other words, the computer technique will not provide the answer to operating problems, but it is a means by which solutions to these problems can be found.

The few examples that have been given serve to show that operations research can assist in the understanding and solution of mining problems. Only the mathematical model and the computer-simulation techniques have been illustrated, but this should not lead to the belief that these are the only analytical techniques operations research has to offer. There is a large selection of methods and techniques, such as, linear and dynamic programming, game theory, etc., etc., which are the "stock-in-trade" of the competent, experienced operations research analyst.

The use of sequential-sampling quality control, for example, may well augment the normal geological methods used in exploration. This technique gives accurate information on the reliability of the data obtained from exploration samples. After the first samples in an exploration have been taken the technique prescribes the positions from which second and subsequent samples should be taken. Not only will this give the required reliability of information; it may also serve to decrease the number of samples required to achieve a desired accuracy of results.

Again, the technique known as linear programming can be used to determine the most-efficient or most-profitable mode of operation of a series of mines working as one unit. Such factors as available tonnage and quality from each mine, transportation and blending costs, and the demand and price structure for products of various qualities could all be taken into account to achieve the optimum solution.

While, therefore, the operations-research analyst may employ abstract mathematics, the numbers he manipulates in such a variety of ways have not just occurred in a vacuum. Each equation represents the essentials of a very real problem of industry, and its solution can nearly always be applied to achieve higher profits and better practice.

FRAMED FOR LONG LIFE

...to give you top performance on haul road maintenance

A strong, stable blade-foundation is essential if a grader is to give you high output. That's why LeTourneau-Westinghouse Adams* graders are given rugged, solid-strength, one-piece frames... that take all of the shocks, twists, and stresses of hardest day-to-day operating conditions.

Continuous-welded... front to rear

Front-to-rear members of the L-W main-frame are heavy steel U-channels. Up front, two full-length channels are welded together to form a box section. Channels separate at top of arch and become two boxes by addition of two heavy steel plates. Frame is continuous-welded from front bolster plate to boxed-in rear-end.

One major advantage of this boxed-channel framing is that it provides *maximum strength without excessive weight.* Result: with the L-W grader, more weight and strength can be built into important components, such as the big 63" L-W circle... none bigger in the industry... where size and strength mean better performance.

Steady blade-mount

This unique L-W main-frame also provides a stable mount for the blade. No matter how tough the going, its solid strength assures a big bite... a smooth, precise finish-surface. No faltering when the blade hits heavy loads or hard-pan... no "riding-up", or deflection.

Operator has clear view of blade

With circle-lift controls mounted forward on frame, both ends of blade are clearly visible to operator, *whether he's sitting or standing.* Clear view of blade assures more accurate grading... and more work done each day.

7 models... 67 to 190 hp

Let us show you any of the 7 high-speed LeTourneau-Westinghouse graders in action. We'll prove to you how these machines can grade faster... more accurately... at less cost. Ask for details and demonstration.

Unique, box-type, L-W Adams one-piece frame runs from front to rear without sharp bends... without joints... without breaking points. Seventy-three years of grader experience have gone into the development of this frame. It's the foundation for L-W grader's rigid, smooth-cutting qualities that get more work done fast... at lowest cost.

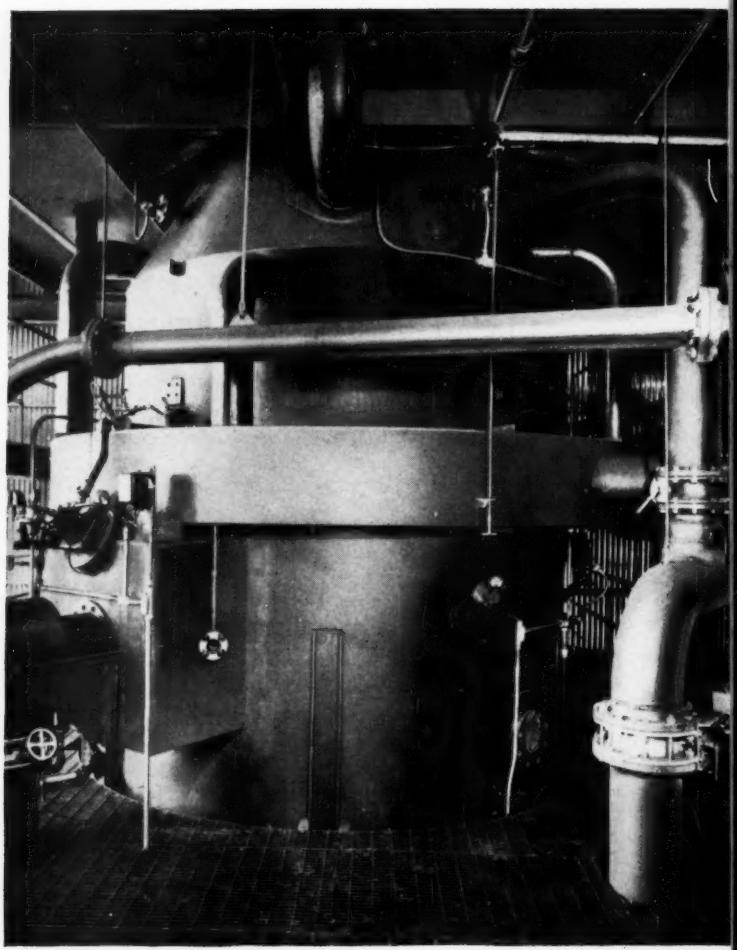
*Trademark G-1955-MQ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

DORRCO FLUOSOLIDS® SYSTEM In Thermal



FIRST INSTALLATION: At Peabody Coal Co.'s Lynville, Indiana, preparation plant, FluoSolids system easily handles feeds of 69-107 tph, with moistures varying from 10.1% to 22.4%.

DORR-OLIVER

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

Paces Progress Coal Drying Technology

Capacity of Dorr-Oliver fluidized installations reaches 2,300 tph of coal as industry adopts new technique for greater drying efficiency, more uniform production

One of the fastest-moving trends in coal preparation is the adoption of fluidized drying techniques in place of other thermal drying methods. The figures for the Dorrco FluoSolids system for coal drying tell the story:

Before July, 1955—No units in operation.

Today—8 units in 7 plants, either on-stream or scheduled for imminent start-up, dry 2,300 tons of coal per hour, removing 40,000 gph of water.

Acceptance of the FluoSolids system reflects the industry trend to fluidization. Dorr-Oliver, leader in the development of this new coal drying method, made the first fluidized drying unit to go onstream . . . is now building the largest (800 tph) . . . has more units on-stream than all other suppliers combined.

Behind the growth in FluoSolids capacity is a record of satisfaction by leading producers who have made the switch from other drying methods. Their experience confirms these inherent advantages in the system:

Greater Economy. Heat required to evaporate one pound of water often is as little as 1600 BTU.

High Capacity. A single 14′ dia. unit can dry up to 800 tph.

High Water Removal. Each dryer can remove up to 50 tph.

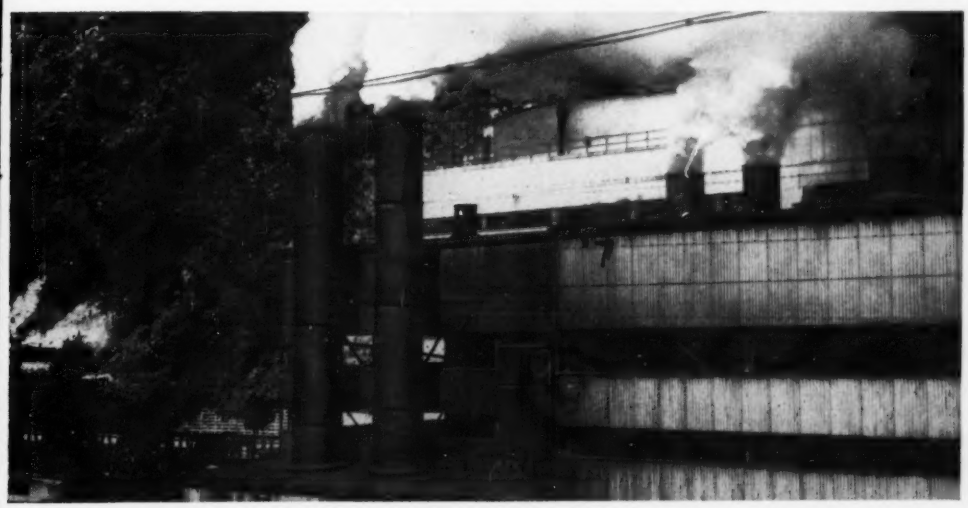
Greatest Feed Size Range. Only Dorrco dryers can handle any feed from filter cake up to 1½″ x 0 coal.

Product Uniformity. Complete instrumentation insures uniform operating conditions, yields a product with no "over or under drying".

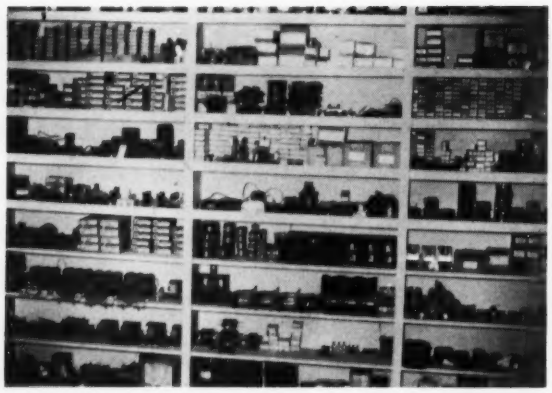
You can make your coal preparation plant more efficient and economical with a fluidized drying unit. And your operations don't have to be king-size. With a Dorrco FluoSolids system, you can handle 75 tph as economically as 800 tph.

For information about the latest on this new technique, drop a line to Dorr-Oliver Incorporated, Stamford, Connecticut.

Dorrco and FluoSolids—T.M. Reg. U. S. Pat. Off.

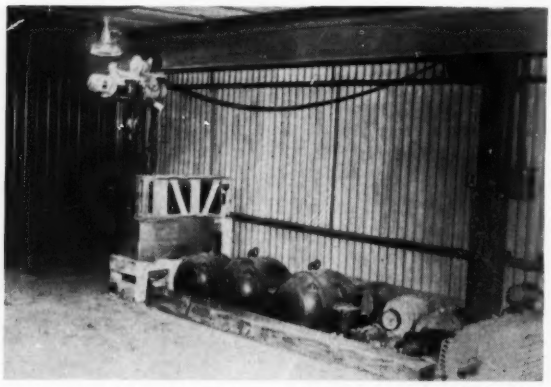


RECENT INSTALLATION: At U. S. Steel's Gary, W. Va., preparation plant, drying section comprises these two 14′ I.D. Dorrco FluoSolids dryers plus auxiliary equipment. These remove 70 tph of water from 600 tph of ¼″ x 0 coal.

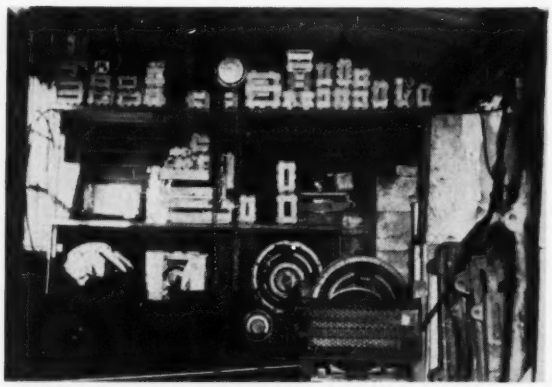


ADEQUATE SHELVING promotes proper classification of parts and good housekeeping. Parts also are better protected.

MOTOR AND SMALL PARTS STORAGE AREA is located in a heated building but is not insulated or sealed.



STORAGE AREA for medium-sized motors is served by a hoist and monorail to ease handling of heavy units.



STORE ROOM is insulated and heated. Shelving could be improved. Improved arrangement would make better use of hoist.

How to Store Electrical Equipment

E. T. Groat
Industrial Sales, General Electric Co.

PROPER STORAGE of electrical parts and spares can often spell the difference between a good maintenance program and a poor one. This is especially true in the mining industry because of the unusual conditions in and around the mines. The storage problem has never been given the attention it deserves nor has there been adequate financing to provide good store rooms. This neglect can be blamed, in part, on a lack of understanding as to what the requirements for ideal storage are and why these requirements are essential in the handling of electrical equipment. The following article is adapted from a paper, "Storage of Electrical Parts and Spares," presented at the Open Pit Mining Association, last year.

PROPER STORAGE of electrical spares and parts is an essential function of any maintenance system. Tens of thousands of dollars are invested in electrical equipment by mining companies to keep machines running and to reduce delay time when they fail. If these parts are not stored properly the inventory will be of little value.

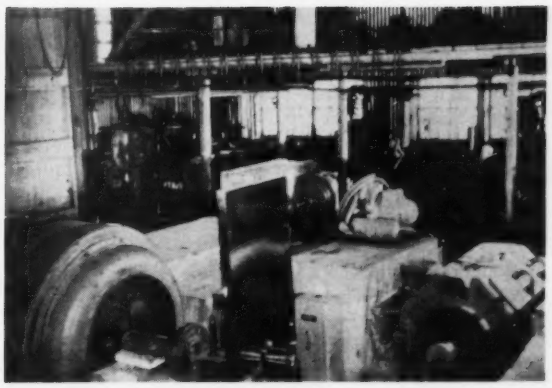
Many of you have had the experience of installing a long-stored spare only to have it fail shortly after it had been placed in service. This results in added expense, loss of production and, sometimes, unpleasant dealings with the supplier.

AC and DC motors, armatures, stators, field coils, control parts, etc., use insulating materials which will deteriorate when storage conditions are unfavorable. Certain combinations of storage and atmospheric conditions are equivalent to deliberately sprinkling water over the stored parts. These conditions prevail when relatively cool spares are suddenly enveloped by a blast of warm moist air on a hot day.

Among the parts previously mentioned the DC armature is the most vulnerable to unfavorable storage conditions. Such armatures also represent your largest investment in stored spares.

Insulation systems are constantly being improved. Manufacturers now offer "sealed" insulation systems that appear practically impervious to dirt and moisture. Protection, however, remains essential for preserving metal surfaces. And on DC machines the commutator is still the most vulnerable part. Consequently, good storage facilities must be maintained to preserve the mica cone and other mica

HEATED STORE ROOM contains boxed armatures, lamps, oil drums, etc. Classification is not practiced here.



LARGE STORAGE AREA with balcony is heated but not insulated or sealed. It could be made into an ideal storage area.

parts of the commutator as well as precision-finished metal surfaces.

Storage Factors

Authorities may differ as to the relative importance of the factors which affect storage conditions but all agree that the following three must be considered in providing ideal storage conditions for electrical equipment.

1. Cleanliness – This is a health factor which is just as important to electrical spares as it is to human beings. An authority on the storage problem recently stated that: "A common enemy of electrical and mechanical parts is dirt, and every effort should be made to keep parts clean. It is easier to prevent dirt contamination than to remove it." Another caution is to exclude all work-shop dirt, fumes and oil vapors from the storage area. It follows that this eliminates locating storage rooms next to shops and garages unless they are completely sealed.

2. Relative Humidity—Authorities again differ as to what the "ideal" relative humidity for a storage area should be. We will compromise on 40% to 60%. This range is considered ideal for commutators and certainly will be satisfactory for other parts.

3. Temperature – Temperatures generally comfortable to humans are satisfactory. This implies heating in winter but not necessarily cooling in the summer.

Basic Approach

Can we attain ideal storage conditions without incurring prohibitive expense? Should we handle and treat items individually or provide suitable store-room space for all electrical parts?

In certain climates it is better to vacuum-pack small items, such as, coils and small armatures, in metal containers. Larger items, including stators and armatures, are often wrapped in polyethylene to exclude dirt and moisture. Very large parts may be stored in large boxes or small rooms that have been completely sealed and dehumidified.

Many materials are available to solve these special packaging problems. These include, among others, vapor-phase inhibitor-treated paper, silica and similar dessicants, anti-fungus agents and vapor-barrier paper. All these materials, when properly used in combination, give the parts a margin of protection.

Care must be exercised even in the proper treatment of steel replacement parts. They should be coated with an acceptable slushing compound. Steel parts should never remain in contact with green lumber or be left in tightly confined cartons made of wood or employing straw or shredded paper for any length of time. There is even a note of caution when storing steel parts in unheated buildings during winter.

Actually, it is much cheaper to adopt the store-room method rather than resorting to costly special packaging. Most companies already have store-room facilities of one type or another. The changes necessary to insulate and seal the existing store-room, provide racks and cabinets and install controlled heating and dehumidifying equipment would represent a relatively small capital outlay. Once equipped, the store-room costs—electricity, steam and labor—would be negligible, whereas the special-packaging method would be a constant charge against maintenance.

The store-room method, in most cases, will be more acceptable to the mining industry. Here are the steps recommended in setting up storage facilities.

1. Classify all spares and parts into groups. Include in the groups requiring special protection all motors and generators, armatures, rotors, stators, coils and control parts. Ball bearings also should be included. Bolts, nuts, large gears, oil and grease drums, electric lamps, etc., certainly do not qualify.

2. Plan the storage layout. Provide monorail chain-and-block facilities with access to all heavy-parts storage areas. An exit to a truck body-level loading platform is essential. Layout also should include covered racks and cabinets for small parts.

3. Make sure that sufficient space is available to store parts properly. Storage arrangement should promote good housekeeping. The store room should be in an area where the air supply is clean and fresh. This will reduce contamination when doors must be opened.

4. Supply adequate heat—steam or electric—to maintain temperature in the generally comfortable range, say 60 F minimum up to summer room temperature.

5. Install dehumidifying equipment to keep relative humidity between 40% to 60%. Self-contained electrically-driven dehumidifiers with drain-

off facilities can be used. A small fan blowing air over copper cold water coils is a practical and inexpensive method of controlling humidity. Incidentally, proper humidity control during the winter heating season will require adding moisture to maintain a relative humidity of at least 40%.

6. Insulate and seal the building. The number of doors should be kept to a minimum and should be of the selfclosing type. Windows are not necessary. To provide maximum protection it may be desirable to install double air-lock doors.

7. Post easily understood instructions concerning the care and use of the store room. Good housekeeping is essential. Frequent use of a vacuum cleaner is recommended. Filters should be used when a fresh-air source is provided.

It may be, in some cases, more economical to provide a small airtight enclosure for large stators, complete motors and generators. The enclosure should be heated with thermostatic control to maintain a temperature of approximately 100 F at all times so that the inside air and machines are always a few degrees warmer than the outside air. This setup provides adequate protection against condensation since we do not have to open doors.

You probably question the omission of air-conditioning. An air conditioner is a machine that cools as well as dehumidifies. Normally it extracts heat from the room and exhausts to the outside. If it exhausted into the room it would be satisfactory; that is, if the condensed water could be collected and drained. However, most modern air conditioners evaporate the condensed moisture with the exhaust air and, therefore, are not applicable in this case. The reason for recommending summer dehumidifying only and not cooling is to prevent condensation on cooled parts. If the parts were cooled by an air conditioner and then exposed to warm humid air when the door was open or for some other reason, condensation would occur.

This article is not a complete study nor are the recommendations final. However, we believe that the fundamental points are sound and hope that each of you will apply these suggestions to your own problems. I predict that your usual group cooperation and communication will produce some novel ideas that are most effective in saving your companies many times the dollars involved in providing a proper storage facility.

One man told me recently that he had no trouble getting approval for the expenditure of $80 to purchase a second-hand air conditioner (notice air conditioner instead of dehumidifier). He showed his boss a ball bearing costing $180 which was still wrapped in wax paper and in the original carton, but damaged beyond repair by rust caused by condensation inside the wrapping.

Even more gratifying was a recent statement by a vice president in charge of operations of one of your companies to the effect that they must direct more attention and spend additional money for adequate store rooms so that spares would be in good condition when needed.

Regardless of the perfection of methods and facilities for storage we still recommend the usual inspection and meggering when electrical spares are placed in service. I am sure that you can see the value of this procedure in uncovering mechanical damage that might have occurred during handling or even while in storage.

A good beginning in . . .

Cost Control for Equipment Maintenance

"CONTROL OF THE TOTAL COST OF COAL PRODUCTION is contingent to a marked degree upon effective control of equipment maintenance." This conclusion plus progress in maintenance control systems is the subject of an article by Wayne M. Walker, assistant works auditor, United States Steel Corp., Fairfield, Ala., in the June, 1959, issue of the *NAA Bulletin*, a publication of the National Association of Accountants. Following is an abstract of the article.

A good maintenance program not only requires that repairs be made to equipment during production shifts but must also include:

1. Periodic inspection and preventive maintenance to minimize losses in production due to equipment failure.

2. A systematic program of providing major equipment components as spares to reduce downtime in the event of breakdowns.

3. A definite program of localized engineering research to improve parts which frequently and unpredictably fail.

4. A systematic program of major equipment overhauls at predetermined intervals.

5. A sound program of equipment replacement at the optimum time based on its economical maintenance life.

6. A predetermination of allowed expenditures based on planned production with periodic comparison—at least weekly—with actual expenditures.

This broad program necessitates a comprehensive cost-control system designed to meet the needs of maintenance and executive management.

Many cost-control systems are designed primarily for production. Time studies, engineering analysis, standard costs, cost analysis, incentive applications and similar techniques are employed to provide management with the necessary tools for cutting production costs. However, a virtually uncharted frontier lies ahead in the establishment of cost-control systems for equipment maintenance.

Experimental Mine

Based on a new maintenance cost-control system, a pilot installation was placed in operation to cover all major face equipment including cutting machines, loaders, shuttle cars, locomotives and air compressors.

The mine, operating 10 sections per shift, has approximately 80 major

FORM T. C. I.

REPAIRS & MAINTENANCE

EQUIPMENT REGISTER

RESP. NAME WOODLAND MINE

DATE 19	UNITS N.T. COAL	BUDGET LABOR	BUDGET MATERIAL	BUDGET TOTAL	ACTUAL LABOR	ACTUAL MATERIAL	ACTUAL TOTAL	VARIANCE LABOR	VARIANCE MATERIAL	VARIANCE TOTAL
JAN.	99910	5085	5195	10290	5152	7444	12596	(57)	(2249)	(2306)
FEB.	82665	4216	4299	8515	2889	3709	6598	1327	590	1917
MAR.	94293	4309	4903	9212	4633	6710	11343	(324)	(1807)	(2131)
TO DATE	276868	13620	14397	28017	12674	17863	30537	946	(3466)	(2520)
APR.	89726	4576	4666	9242	3623	5785	9408	953	(1119)	(166)
MAY	92654	4725	4818	9543	5806	5719	11525	(1081)	(901)	(1982)
JUN.	80580	4110	4190	8300	4637	7004	11641	(527)	(2814)	(3341)
TO DATE	539828	27031	28071	55102	26740	36371	63111	291	(8300)	(8009)
JUL.										
DEC.										
TO DATE										

Figures are hypothetical.
Note: Parentheses denote red figure.

VARIANCE PER CENT. YEAR TO DATE

% LOSS ← → % GAIN

CODE	DESCRIPTION	RESP. NO
9114	14 BU Loader	991

FIG. 1—Repairs and maintenance equipment register.

units of equipment assigned to 11 different sections, including one spare.

Personnel for each section consists of a production crew, direct sectional service crew, repairman and foreman.

The duties of the section repairman are to inspect, lubricate and perform emergency repairs. Maintenance crews consist of an underground roving repair crew, underground motor-pit crew and a surface repair-shop crew.

Each section of the mine is scheduled to be idle periodically. During these periods the roving repair crew makes regularly scheduled trips to the idle section. The crew works on the equipment for two or more consecutive shifts, thoroughly inspecting and undertaking preventive maintenance functions that would otherwise cause delays if performed during operating shifts.

One function of the motor-pit crew is to procure repair parts from the storehouse for emergency repairs, which normally are performed at the motor pit or on the section. In addition, this crew repairs and rebuilds assemblies, inspects and lubricates sectional and mainline locomotives, and other underground equipment.

The surface shop-repair crew performs regularly scheduled major equipment overhauls requiring shop facilities and also maintains surface equipment.

Equipment Parts—Due to the relatively short life of mining equipment and continuing improvements in design, the 80 major units of the five basic types of machines previously listed might include 15 different models. This means that, on the average, only five machines are of the same model.

By eliminating parts which are interchangeable, there are about 10,000 different parts which are considered critical insofar as operation and maintenance are concerned.

The loading machine, for example, has approximately 4,500 parts of which some 1,500 are different. Eliminating frame and support parts and hardware items, such as, bolts, oil seals, cap screws, standard fittings, etc., there remain about 800 different parts which can be considered critical.

Control Objectives, Basic Records

The objective of a maintenance cost-control program is primarily to provide adequate detail recording which will permit pin-pointing specific parts for study. This program also should permit follow-up to determine if remedial action is effective and, in addition, should provide information for determining comparative merits of equipment from different manufacturers. Further, it should provide adequate information on which to base decisions with respect to retiring equipment nearing the end of its economic maintenance life. A long-range objective should be to provide a method of determining labor performance on maintenance.

Records—Maintenance records are detailed, generally, to class of equipment. These records show budgeted repairs and maintenance cost, actual cost, and variance for the month and quarterly year-to-date totals.

Control data are recorded on visible-edge cards which are filed in book units. Separate cards are maintained for each class of equipment for each mine. Units of production or net tons of coal handled by the respective classes of equipment are recorded on these cards. Maintenance costs are detailed as to labor and material, and the budgeted as well as actual costs and variances are shown.

A colored signal along the edge of each card indicates percentage variance for the year-to-date, favorable or unfavorable.

Fig. 1—repairs and maintenance equipment register—shows that material usage for loaders has exceeded the budget for the year-to-date by $8,300 or 29.5%, whereas labor reflects a favorable variance of $291, or a 1.1% gain.

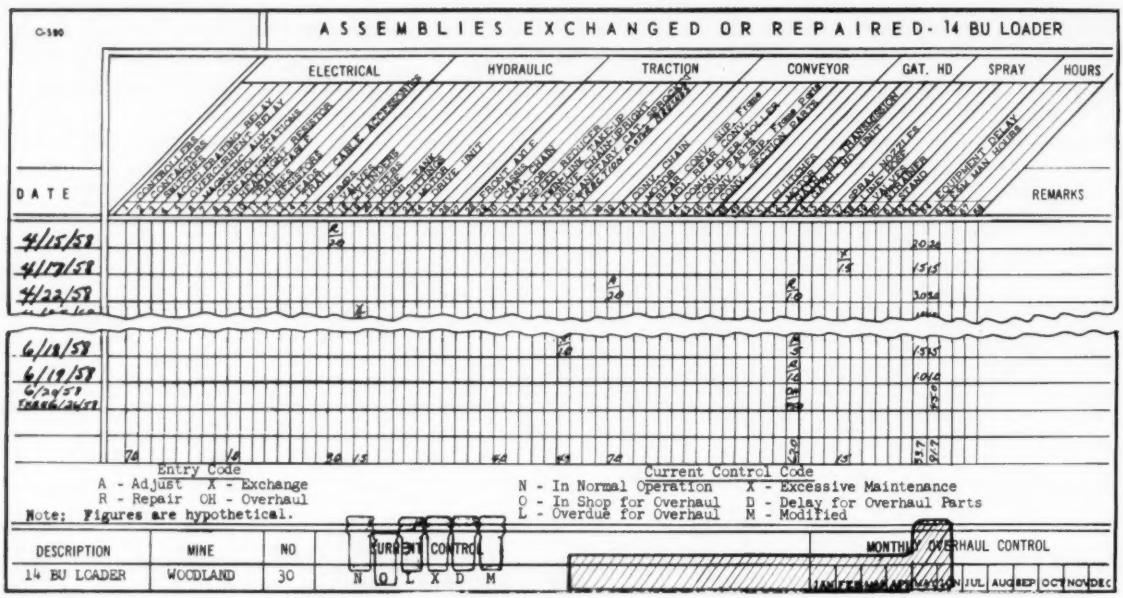


FIG. 2—Assemblies exchanged or repaired card.

DATE	EQUIP.	TCI NO.	R X A *	O H **	SCH. REP ***	PARTS USED CATALOG NO.	PARTS USED DESCRIPTION	EQUIP DELAY	MAN HOL.
5/28/58	14 BU.	20	R			2 ea 6154U20 Bearings 2 ea 7806 Dust Rings	} Repaired Swivel Assy.	6.0	6.0
5/28/58		28	R			1 ea 4343-43	Repaired Drive Chain	.8	8
5/31/58		38	R			2 ea 6154U20 Bearings 2 ea 7806 Dust Rings 1 ea 4066 Swivel Asm.	} X Out Swivel Asm. & Bearings	4.0	4.0
6/4/58		2	M			1 ea Key Stock	X Out Drive Chain & Sprocket	3.0	3.0
6/13/58		29	R			1-97164 Oil Seal	Repaired Head Unit	5.0 3	50 3
							Note: Figures are hypothetical.		
						*Work performed by Sectional Repairman. **Work performed by Surface Repair Shop Crew. ***Work performed by Roving Repair Crew.			
CAT. NO.		ASSEMBLY DESCRIPTION				MODEL	DRAWING NO.	REF. NO.	
U-106-28A		GATHERING HEAD UNIT				14BU-7RBE	U-106-28A	54	

FIG. 3—Parts-used card.

Although indicative of over-all trends, these records are inadequate with respect to focusing attention on specific causes of excessive maintenance costs and delays.

Historical-Data Record System

Specific historical data are recorded on two general types of cards which are filed in the maintenance superintendent's office.

Fig. 2—assemblies exchanged or repaired card—is an example of the master or accumulator card. The headings on this card vary with the type of equipment. Across the top are headings for data and name of assemblies or components classified as to major categories, such as, electrical, hydraulic, traction, conveyor, spray, etc., as well as equipment-delay hours and maintenance man-hours. A separate card is provided for each major equipment item.

Entries show the date and, under the appropriate assembly, also show by symbol whether that assembly was repaired, exchanged or adjusted, and the maintenance man-hours involved.

The visible edge of the card, in addition to equipment description and number, indicates the status as to scheduled overhaul, whether equipment is in active use or is a spare undergoing overhaul, or waiting for parts.

For example, Fig. 2 denotes that Loader No. 30 is in the shop for overhaul (note current-control section on the card). By scanning the card it is noted that frequent failures of the gathering-head unit have occurred. In addition to cost of labor and parts involved in making repairs, delay costs are a significant portion of the total cost of equipment failure.

Based on the concept that all mining costs can be absorbed only by sectional face time, the cost of a sectional delay of 1 hr is approximately $100. Thus, we find for the period shown that total delay time (Column 64) was 33.7 sectional hours, evaluated at $3,370. Delay time, however, does not necessarily coincide with total maintenance man-hours. For example, delays on the gathering-head unit (Column 54) totaled 11 hr at a cost of $1,000, but two entries—6 and 45 maintenance man-hours—did not involve delays.

Fig. 3 shows the parts-used card which accompanies the historical data record system. This card provides space for date, equipment classification and number and, by symbol, whether the work was performed by the sectional repairman, surface shop crew or the roving repair crew.

Parts used are detailed by catalog number and description. Delay time and maintenance hours involved also are recorded. Small hardware, such as, bolts, cap screws, lock washers, etc., are not recorded.

Entries on these two visible-record cards are based on reports prepared by the various repair crews. Posting is performed by an accounting employee who reviews and analyzes the accumulated data, and reports the results to the superintendent for cor-

COST PER 100 MACHINE OPERATING HOURS

ASSEMBLY NO.	ASSEMBLY DESCRIPTION	EQUIP. CLASS	EQUIP. NO.	LISTING DETERMINATE AMOUNT MACH.	LISTING DETERMINATE AMOUNT PART	OPERATING MAINTENANCE THIS MONTH LABOR LUBE INSP. & ADJ.	LABOR EXCH. ASSEM.	LABOR REPAIR	CRITICAL PARTS	DELAY COSTS	TOTAL	YEAR-TO-DATE OPERATING MAINTENANCE LABOR LUBE INSP. & ADJ.	LABOR EXCH. ASSEM.	LABOR REPAIR	CRITICAL PARTS	DELAY COSTS	TOTAL	OVERHAUL LABOR	OVERHAUL CRITICAL PARTS	OVERHAUL TOTAL
54	GATHERING	14BU	29	25.00	15.00			5.00	14.00	-	19.00		1.50	2.88	8.90	25.50	38.78	-	-	-
"	HEAD UNIT	"	30	"	"			10.50	20.15	49.50	80.15		-	9.20	26.45	37.80	73.45	11.15	16.27	27.42
"	" "	"	"	"	"															
"	" "	"	"	"	"															
"	" "	"	"	"	"															

MONTH OF JUNE, 1958

CRITICAL PARTS (LISTED ON EXCEPTION BASIS)

PART NO.	PART DESCRIPTION	QUANTITY THIS MONTH REGULAR MAINT.	QUANTITY THIS MONTH OVERHAUL	QUANTITY YEAR-TO-DATE REGULAR MAINT.	QUANTITY YEAR-TO-DATE OVERHAUL	QUANTITY YEAR-TO-DATE TOTAL	QUANTITY PER 1000 EQUIPMENT OPERATING HOURS THIS MONTH	QUANTITY PER 1000 EQUIPMENT OPERATING HOURS YR. TO DATE	COST PER 1000 EQUIPMENT OPERATING HOURS THIS MONTH	COST PER 1000 EQUIPMENT OPERATING HOURS YR. TO DATE
		-	-	-	-	-	-	-	-	-
14041	SPROCKET	1		1		1	3.33	.96	112.07	32.31
4343-1	DRIVE CHAIN LINK	1		4		4	3.33	3.33	2.57	2.57
4343-42	DRIVE CHAIN	1		1		1	3.33	.96	86.81	25.02
6139420	BEARING		4	3	4	7	13.33	5.83	182.55	79.84
7886	DUST RING		4	3	4	7	13.33	5.83	4.67	2.04
14060	SWIVEL ARM		1	2	1	3	3.33	2.50	342.08	256.82

FIG. 4—Report of selected repetitive maintenance costs.

rective action, on an exception basis.

The superintendent of maintenance reviews, for indicated trends, data furnished him from the visible records. He then assigns engineers to make preliminary investigations of parts that warrant specific study. After adequate information has been developed, a "brainstorming" session is held, usually at the monthly maintenance meeting, to determine course of action.

Probing Parts Failures

Another planned feature is a report which, on an exception basis, will pinpoint areas of repetitive equipment failure. A report of selected repetitive maintenance costs by equipment assembly and part number (see Fig. 4) has already been designed to meet this need. This report is divided into two sections and will be prepared monthly. One section summarizes by assembly the cost per 100 equipment operating hours of the regular maintenance—detailed by labor, critical parts used and delay costs—and cost of equipment overhaul—detailed by labor and critical parts used. This information is shown for month and year-to-date. When the cost per 100 equipment operating hours for an equipment class exceeds a predetermined cost set by engineering and historical studies (which can be revised by changing the listing determinant amount), the detail by individual equipment number will be printed on the report.

The other section of the report involves specific parts used. The initial detail will be on a selective basis when the cost per 100 equipment operating hours for an individual piece of equipment exceeds a predetermined amount set by engineering studies. This listing will be based on a request from the superintendent of maintenance for the entire record on usage of parts specified in his request. Generally, the list will be based on information shown on prior reports which indicated the need for special engineering study.

The selected listing determinant for summary information on loaders is $25 or more per 100 machine operating hours. The total cost of Loader 29 (see Fig. 4) exceeded this amount; therefore it was listed. Since the critical parts costs, however, did not amount to as much as $15 per 100 machine operating hours (the listing determinant amount for critical parts), the parts detail was not shown. The cost of Loader 30 exceeded the total of $25 and of $15 for parts. Therefore, the complete detail was printed for this equipment. A study of the critical parts used on Loader 30 focuses attention on several specific items.

Comparing Equipment

For use in evaluating the comparative merits of equipment from different manufacturers and to provide basic information for use in determining the optimum time to replace the equipment based on its economic maintenance life, an annual report is prepared on total maintenance experience for each piece of equipment. A similar report may be prepared at any time for each class of equipment for investment appropriation considerations.

A Good Beginning

Based on experience in this pilot installation, the benefits from such a record system, though mostly intangible, have a substantial potential. During the period the system has been in effect, maintenance cost has been reduced approximately 7%. Numerous changes in design have been made and incorporated in new equipment. Manufacturers have furnished modification kits, some at no charge, for use in altering present equipment. Experience has been that, when specific instances of failure can be cited to the manufacturer, more attention is given to correcting the defects or improving the parts involved.

Experience also indicates that the pilot system is the beginning of a very effective control of maintenance costs. Plans to achieve full coverage are under way.

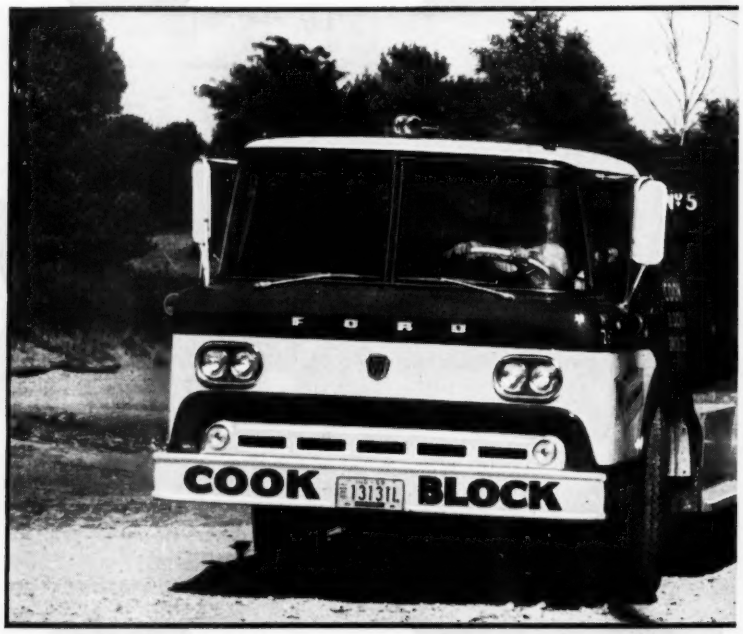
It is recognized that this system comprehends recording and selecting for reporting on an exception basis such a mass of data as to preclude its timely availability for use if handled manually. The most efficient administration of such a system necessitates use of punched-card equipment or use of electronic computers, which is a part of future plans.

Here's another reason why Ford Trucks are your best buy!

"OF ALL THE MAKES WE'VE TRIED FORD TRUCKS GIVE US THE LOWEST MAINTENANCE COST!"

ANOTHER REPEAT BUYER OF FORD TRUCKS

Virgil E. Cook, owner of Cook Block and Brick Co., is convincing proof that there is still plenty of opportunity in American business for those sound planning, hard working individuals who want to own their own business. Starting from scratch just 13 years ago, he now owns and operates one of the largest concrete products plants in Eastern Indiana. The workhorses in his fleet of 16 trucks are three Ford Tilt Cab Tandems that are used to haul sand and gravel to the plant and make deliveries in and around Anderson.



Hard-working Ford CT-950 tractor leaves Cook gravel pit with 18 yards of aggregate. Aluminum walking beam and rubber suspension system of tandem axle assembly reduce chassis weight, permit higher legal payloads.

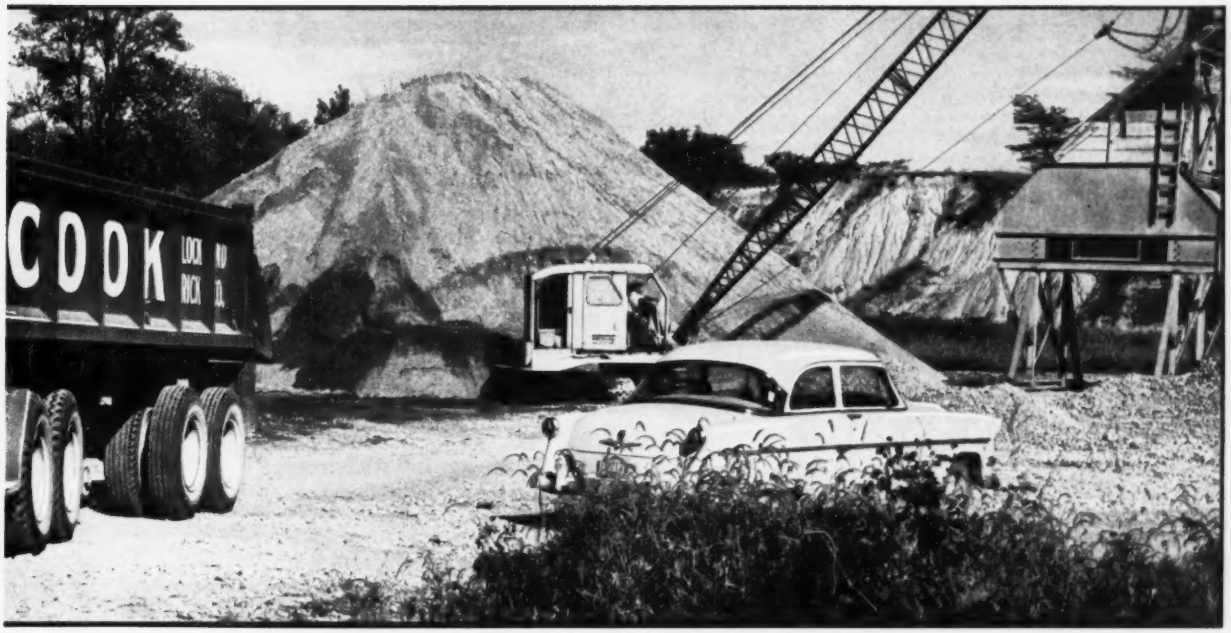
Cook's CT-850 with special flat-bed body and Side-O-Matic unloader delivers blocks right to the job site. Unit carries 600 concrete blocks and spots them where needed.

"Our experience has proved that Ford Trucks can be operated at substantially lower maintenance costs than any other make we've tried. And, equally important in a fleet like ours, we find that our Fords spend much less time in the shop. None of the Ford units purchased since 1958 have been in for major repairs and I am still amazed at the way the older ones keep going.

"The best truck we've ever owned is a 1954 Ford C-700 that consistently carries a load of 350 to 400 blocks over all types of terrain. In spite of this severe work it ran 125,000 miles before we replaced the engine. This unit now has over 140,000 miles on the original ring gear and pinion and it went 60,000 miles before we relined the brakes and put in a new clutch. This is outstanding mileage when you consider that we've realized as little as 12,000 miles from competitive ring gear and pinion sets. Clutch and brake life obtained with other makes in identical service was only 20,000 miles. It's results like this that keep our costs low and convinced us that we should stay with Fords when we bought our bigger trucks in '58.

"Our 1958 and 1959 Ford Tilt Cab Tandems give every indication of equalling or surpassing the fine records set by the C-700. The two CT-950 tractors hauling sand and aggregates to our processing plant breeze through traffic and take the hills like they weren't there at all. Our CT-850 equipped with a flat-bed body has the power and traction to deliver finished products anywhere. With Ford's tilt-cab design we get a real plus as far as payload is concerned because we can carry at least 2,000 pounds more weight on the front axle.

"We buy Ford Tilt Cab Trucks because we think they're the best engineered and most modern gasoline trucks in the heavy-duty field. Here at last is a truck built to permit big legal payloads with enough power to move these loads at economical speeds. We pride ourselves on our modern and efficient equipment and consider our Fords one of the most valuable assets of our business."



'60 Fords are built for longer life . . . with Certified Durability!

Whatever your job . . . wherever you do it . . . you'll discover just as Mr. Cook did, that Ford Trucks are the best investment for your transportation dollar.

Certified results of tests conducted by America's leading independent research organization (name available on request) confirm the fact that Ford Super Duties have been refined for still more durability! Automatic radiator shutters, improved electric fuel pumps and redesigned wiring harnesses are typical of the advancements to be found in these units.

Automatic radiator shutters reduced the coolant temperature variation recorded in severe mountain road tests from a 79° range to a 20° range. Engine operation with coolant temperatures in the 167° to 187° range means less expansion and contraction, more efficient combustion and better lubrication . . . all of which contribute to longer engine life.

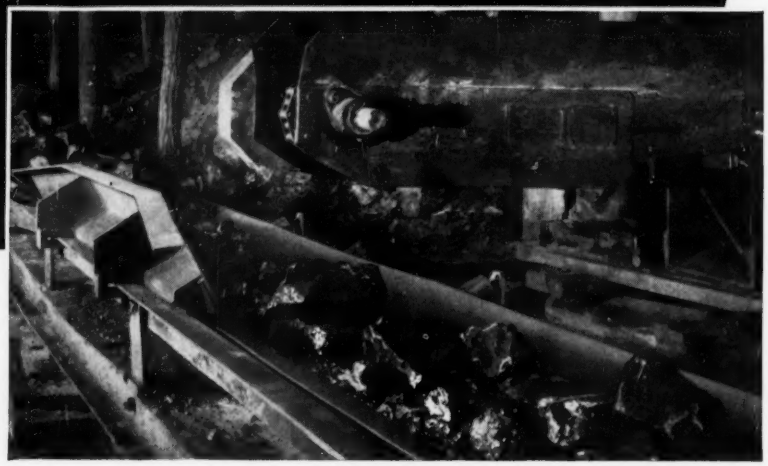
Dynamometer tests showed *no vapor lock* with Ford's submerged-type electric fuel pump at temperatures up to 200°. Incipient vapor lock with mechanical fuel pump resulted in a power loss of 9% under the same conditions. Shaker table tests plus constant exposure to oil, water and heat proved 1960 wiring harness to be *three times longer lived.*

FORD TRUCKS COST LESS

LESS TO OWN . . . LESS TO RUN . . . BUILT TO LAST LONGER, TOO!

NOW... R/M's NEW "Coalmover" CONVEYOR BELT

SETS THE STANDARD FOR COAL MINE PERFORMANCE!



HAULS MORE COAL! LASTS LONGER! COSTS LESS!

Introducing the latest product of R/M rubber research and development for the coal industry. R/M Coalmover—new conveyor belt designed and engineered for underground coal mining . . . job-proven in all types of underground conveyors. Compare these advantages with any other belt on the market—you get them *all only* with R/M Coalmover!

Light in Weight—easy to handle and re-spool for advancing and retreating

Superior Fastener Holding Ability—holds *all* makes of fasteners *longer*, reduces maintenance costs

Solid Edge Construction—scuff resistant, will not fray or fan out

Fire Resistant Cover Top *and* Bottom— can haul on either side

Exceptional Pulley Grip—permits operation at lower tension *without* slip

High Coefficient of Friction—no slippage or spillage as with plastic covered belts

Maximum Rip Resistance—service life protected against wear, tear, gouging and abrasion

Low Stretch—requires minimum take-up adjustment

Rugged Impact Resistance *plus* Exceptional Flexibility—lasts longer over reverse bend or snub pulleys

Troughs Easily, Trains Naturally—haul *full* loads even in low-head room installations

Is not thermoplastic—does not stiffen up at low temperatures, is quiet running

FIRE RESISTANT!

Like all Manhattan Underground Conveyor Belts, new R/M Coalmover is mildew-proof, moisture resistant—and certified with Bureau of Mines' acceptance designation: "Fire-Resistant, U.S.B.M. No. 28-10."

COALMOVER IS NOT A PLASTIC COVERED BELT. ASK YOUR REPRESENTATIVE FOR DETAILS ABOUT R/M's NEW CONSTRUCTION ENGINEERED TO GIVE YOU "MORE USE PER DOLLAR" IN YOUR MINING OPERATIONS.

RM-1021

RAYBESTOS-MANHATTAN, INC.

MANHATTAN RUBBER DIVISION, PASSAIC, NEW JERSEY

RM

ENGINEERED RUBBER PRODUCTS . . . MORE USE PER DOLLAR

WHAT'S WRONG WITH THIS PICTURE?

Something backwards, maybe? Sure, the dragline. It's working from the spoil pile, not the highwall.

Maybe it seems backwards, but there's nothing backward about this operator who is uncovering 30% more coal in a given period of time than he was with conventional methods. And he's cut bulldozer reclamation time, and dragline maintenance costs too.

This new development is "explosives stripping" . . . heavy shooting with overburden loaded to at least 1 lb. of blasting agent per cubic yard. Sure, drilling and explosives costs are higher . . . about 20%. But look what happens! Up to 40% of the muck is moved right onto the spoil pile without *any* mechanical handling. That's a lot of overburden you don't have to handle.

Breakage is better, digging easier. Digging methods are easy too. The drag works from one end of the shot at a slight angle to the highwall, cutting a keyway. Then, with a bulldozer smoothing the way, it walks right along the spoil pile dragging from the keyway. As the material is scooped off, the dragline swing becomes less and digging efficiency goes up even more.

This is a new development you can't afford to ignore, but you may have to see it to believe it. Ask your Atlas representative where you can observe this stripping practice. See if it can be adapted to your conditions.

EXPLOSIVES DIVISION

ATLAS POWDER COMPANY

WILMINGTON 99, DELAWARE

Offices in principal cities

Lima announces new 5-yd. shovel, 140-ton special crane

TYPE 1800

- Standard 5-yd. shovel with 35-ft. boom, 26-ft., 10-in. dipper handle; 7 or 8-yd. dipper for coal handling
- Converts to 112-ton crane
- Variable capacity dragline

TYPE 1800SC

- 140-ton special crane with 21-ft. wide truck base for stability with big lifts
- Converts to variable capacity dragline

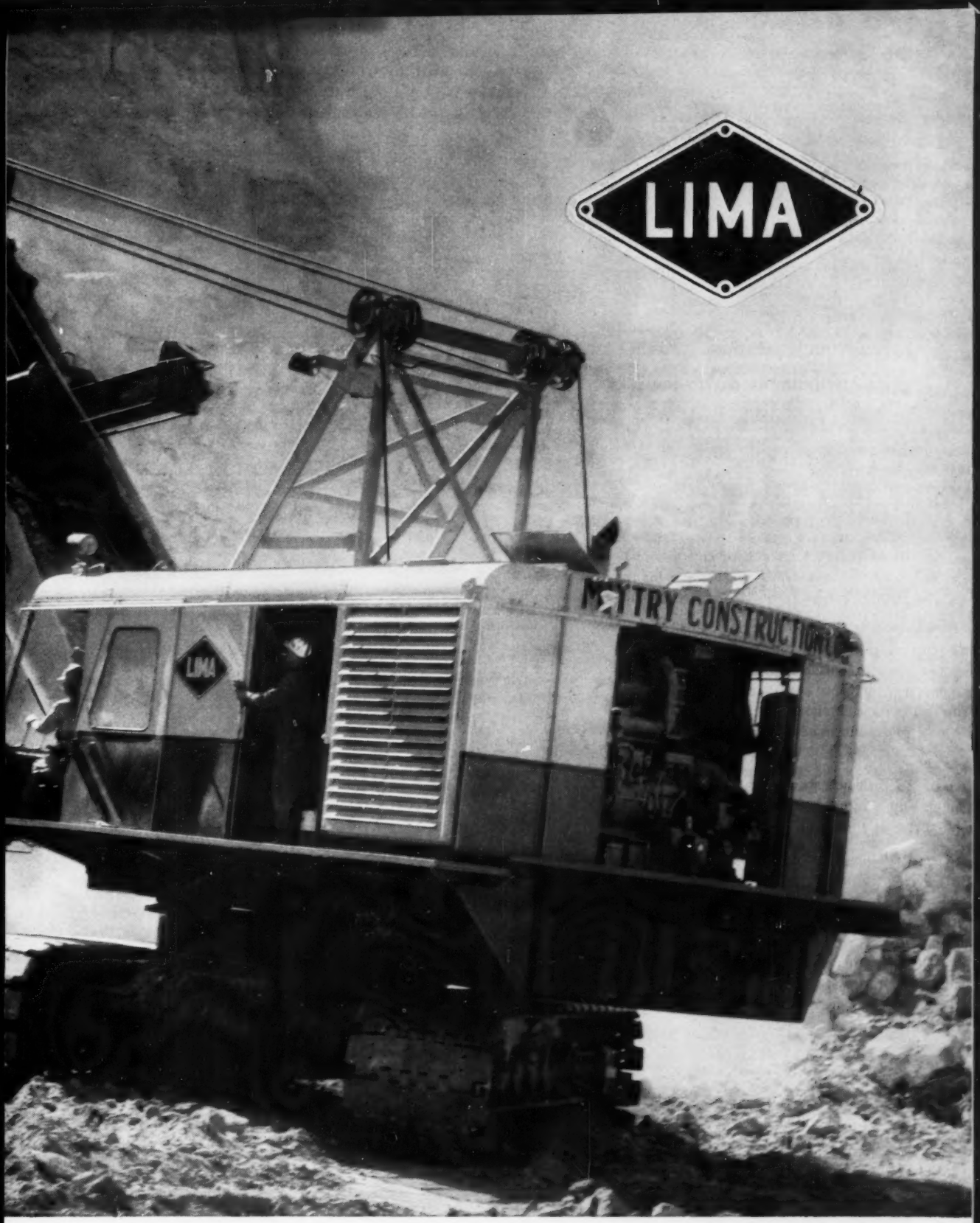
These new Limas are designed to permit knock down for job to job transportation. Side assemblies come off as a unit—including belts, crawler chains and sprockets. Counterweights are removable. Backhitch-telescopic-type gantry folds down to 17-ft., 5-in. overhead clearance.

LOW MAINTENANCE REQUIREMENTS—You get more for your money when you buy a LIMA. They last longer, perform better, and require less maintenance. Lima offers you all of these important features in a single machine—

- **Air control**
- **Torque converter drive**
- **Anti-friction bearings at all important bearing points**
- **Large diameter clutches and brakes**
- **Two-shoe-type swing-propel clutches**
- **Combination rope-chain crowd**
- **Single-inside-type dipper handle, 15″ square**
- **Extra long crane booms and special jibs available**
- **Convertible to crane or dragline**
- **9′-10¼″ dia. roller path**
- **Six cone rollers, six hook rollers**
- **Standard or long, wide crawlers**
- **Diesel or electric power**
- **Knock down for highway transportation**
- **Independent two-drum boom hoist**
- **Independent propel**
- **Auxiliary third drum**
- **Power load lowering**

FACTS AND FIGURES on the new 1800 and 1800SC are yours for the asking. See your nearby Lima distributor today or write to Baldwin-Lima-Hamilton Corporation, Construction Equipment Division, Lima, Ohio.

Lima Type 1800 5-yd. shovel—one of five Limas owned by Mittry Construction, Los Angeles. Shown excavating at Abiquiu earth fill dam project, Shama River, N. Mex.



LIMA Construction Equipment Division, Lima, Ohio

BALDWIN · LIMA · HAMILTON

Shovels • Cranes • Draglines • Pullshovels • Roadpackers • Crushing, Screening and Washing Equipment

600

Long-range planning of over-all pit operations plus close attention to day-to-day problems provide the basis for successful stripping in water-soaked flat areas near stream level. Preparation facilities meet today's needs, anticipate tomorrow's problems.

PACESETTER at 750,000-ton Shamrock mine is 16-yd dragline that moves up to 18,000 cu yd per day in thin cover. Unit works around the clock five days a week.

Badgett Beats Waterlogged Cover

WATERLOGGED OVERBURDEN continually challenges management ingenuity at Badgett Mine Stripping Corp.'s new Shamrock mine near Nebo, Hopkins County, Ky. But Badgett successfully overcomes the water problem to mine 3,800 tons of raw coal in single-shift loading. This coal feeds to a new aluminum-clad preparation plant where it is washed, dried and sized before flowing to one or more of the three loading tracks.

LOADING-HAULING TEAM includes 5¼-yd diesel shovel and fleet of 25-ton coal haulers. Trucks usually travel on top of coal when entering and leaving pit.

Badgett not only is experienced in strip mining but also is active in the construction business. For example, the company recently completed a section of the St. Lawrence Seaway and over the years has built a number of highways throughout the country. It was near the completion of work on the seaway that Badgett focused attention on developing an untapped reserve of coal in western Kentucky. The upshot was that in January, 1958, the company transferred a Bucyrus-Erie 5W dragline from the Seaway project to start preliminary work at the new Shamrock mine. This preliminary work included building main haul roads and constructing dams to create a lake which would provide fresh water for the preparation plant. Shortly after the drag went to work, the company

END VIEW of pit shows 6 ft of water-logged material removed from next cut to provide firm footing.

MAIN SUMP at lower edge of property receives water from active pit. Truck-mounted pump relays it through aluminum pipe to drainage ditch.

ROTARY drill is called into service when hard shale appears in overburden.

In Western Kentucky

added several Euclid scrapers to help with the earthmoving job.

Shortly after road construction began, Badgett management met with Roberts & Schaefer engineers to discuss plans for the design and construction of preparation facilities that would be capable of processing coal not only from the No. 11 seam but also from the No. 13. Although anticipating a number of years work in the No. 11 seam, the company wanted a plant that would be able to handle the No. 13 coal when it was mined. As a result of the discussions, Roberts & Schaefer engineers recommended a plant that would incorporate two-stage jig washing and mechanical drying of the fines. On March 1, 1958, Badgett signed a contract with Roberts & Schaefer and construction began the following July.

Rogers S. Badgett, president, heads the company's mining and construction projects and has his office in Madisonville, Ky. Other executives headquartering there are Brown Badgett, vice president; C. W. Badger, vice president; and Bentley F. Badgett, secretary-treasurer. Directly in charge of operations at the Shamrock mine is Ross Thomas, superintendent. Other key Shamrock staffers are Morton Wellborn, assistant superintendent; Gene Knight, office manager; Lex Bowman, parts manager; Jewell Carter, pit foreman; Frank Grigg, plant superintendent; and Wesley Taylor, master mechanic.

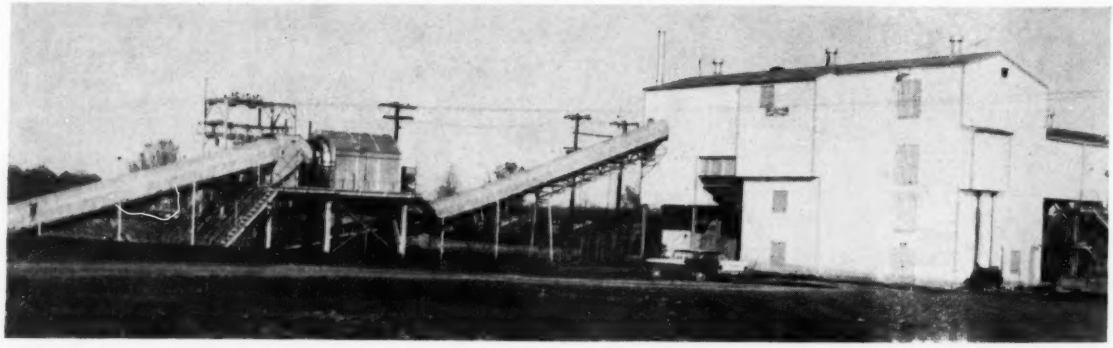
All of Badgett's production is sold by the Nashville Coal Co., Inc., and travels to markets over the L & N and Illinois Central railroads. About 90% of the output moves to northern markets.

Opening the Pit

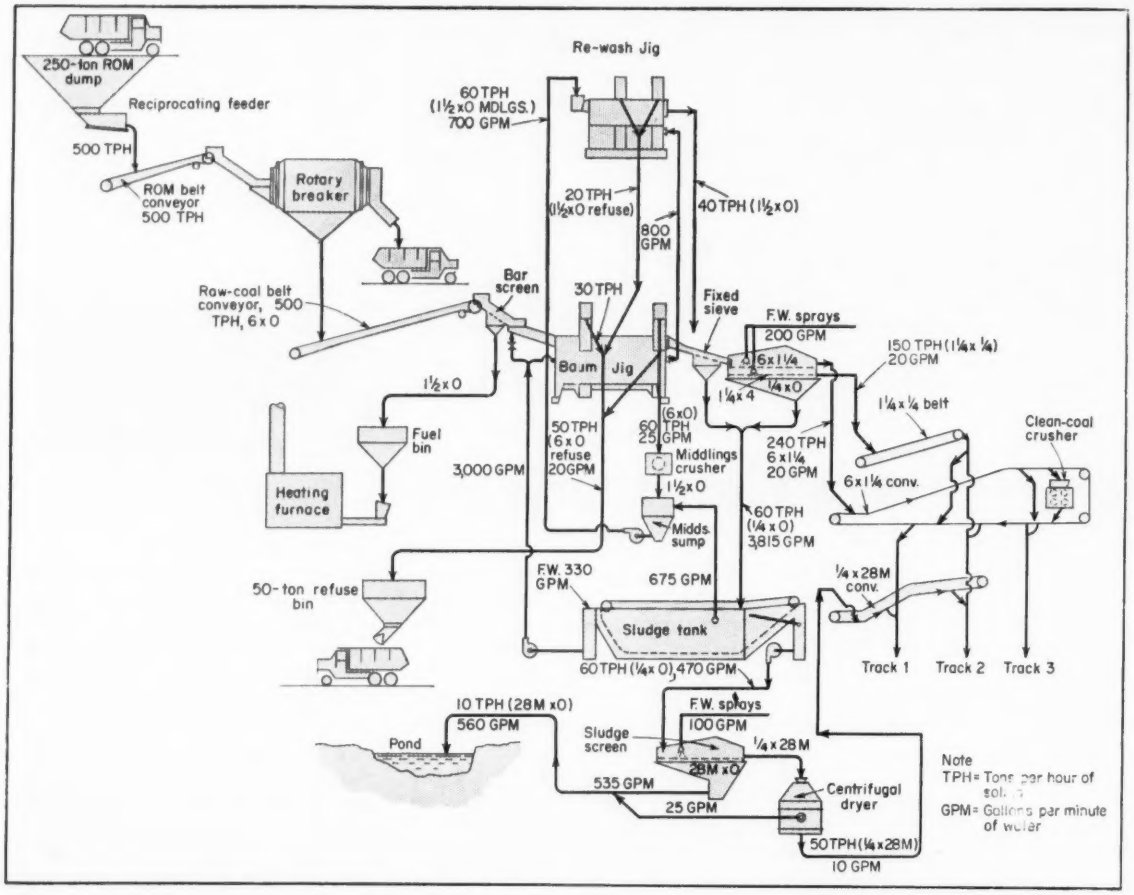
By Nov. 15, 1958, the 6-yd dragline and the scrapers had completed the roads and dams. The dragline then moved to the southern edge of the property and began stripping the coal seam near its low point. Before starting actual stripping, however, the company enlarged a drainage ditch that cut through the property in a north-south direction. The stripping plan called for taking as wide a cut as possible along the southern edge of the property, beginning at the western property line and ending at the north-south drainage ditch.

By tackling the property this way management planned to use the spoil to build a levee along the southern edge of the property. This levee would prevent stream backwater from flooding the property. Furthermore, as soon as the first cut of coal was removed the pit could serve as a sump for most of the property.

Working in water-logged dirt and clay 18 ft thick, the dragline exposed a 90-ft strip of coal. This early stripping was done without the aid of explosives to loosen the overburden.



PREPARATION PLANT includes primary crushing in outdoor rotary breaker, two-stage jig washing, screening, centrifugal drying and oil treating. Plant is designed to meet future needs when second seam is mined.

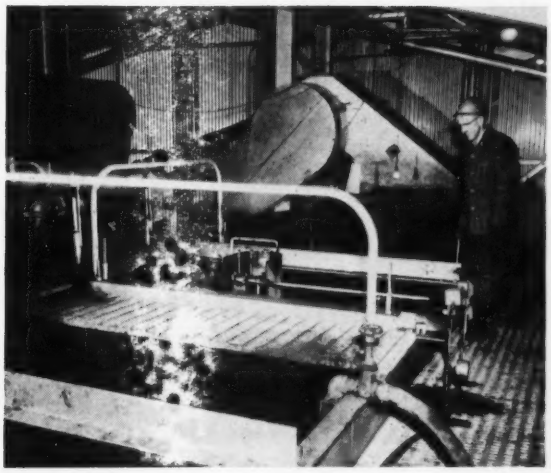


HOW COAL FLOWS through Badgett's Shamrock preparation plant. Aluminum-clad plant processes 500 tph.

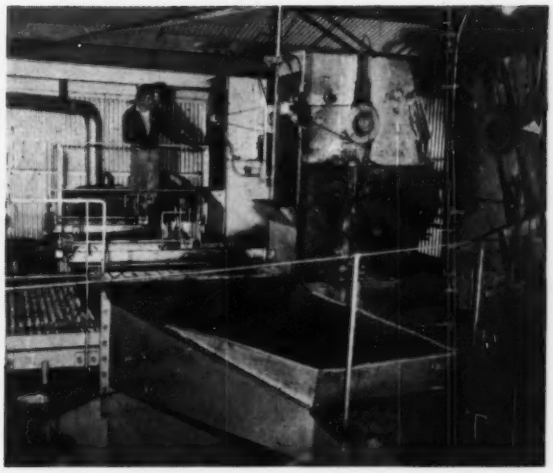
In January, 1959, the company purchased an electric 650B dragline to replace the 6-yd machine. This unit was erected on the property and went to work in mid-April, replacing the 6-yd unit.

Swinging a 16-yd bucket from its 195-ft boom, the 650B can cut a swath 150 ft wide through the thin overburden. It usually cuts a pit 100 ft wide. When the overburden gets thicker as future cuts are taken, pit width will be reduced to 75 ft.

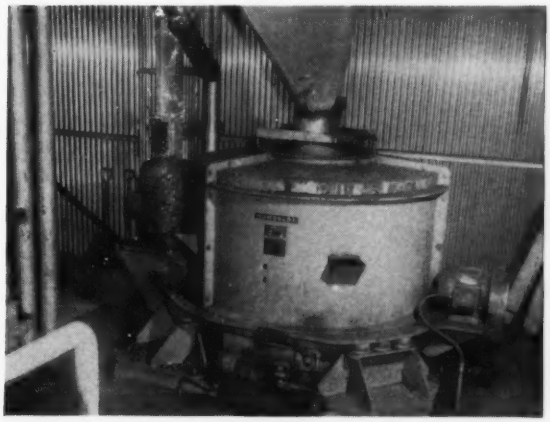
By Nov. 15, 1959, the 16-yd stripping unit had completed the levee from the western edge of the property to the drainage ditch and now is taking a similar cut east of the drainway to build a levee from the ditch to a nearby hill to complete the second stage of the water control program. The third stage of the water-control program will include building a low dam from the hill to the roadbed of the L & N R. R. When this work is completed and the first cut of coal removed along the southern edge of the property, the company plans to work back and forth across the property. Coal in



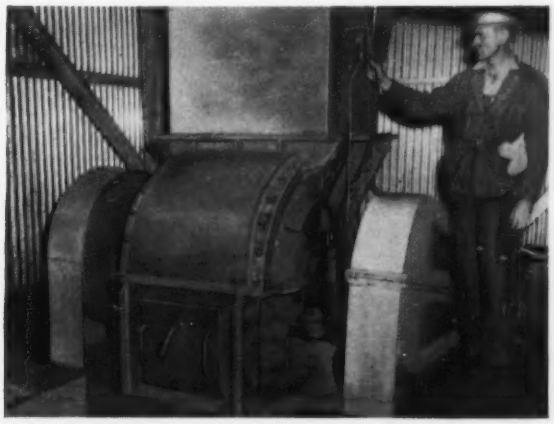
PRIMARY JIG receives 6x0 via flume, makes three-product separation of clean coal, middlings and refuse.



SECONDARY JIG washes crushed middlings from primary unit, makes separation into coal and refuse.



CENTRIFUGAL DRYER receives ¼x28M from dewatering vibrator, reduces surface moisture to 5%. Unit processes 50 tph.



MIDDLINGS CRUSHER reduces 6x0 intermediate product from primary jig to 1½x0 for rewashing in second jig.

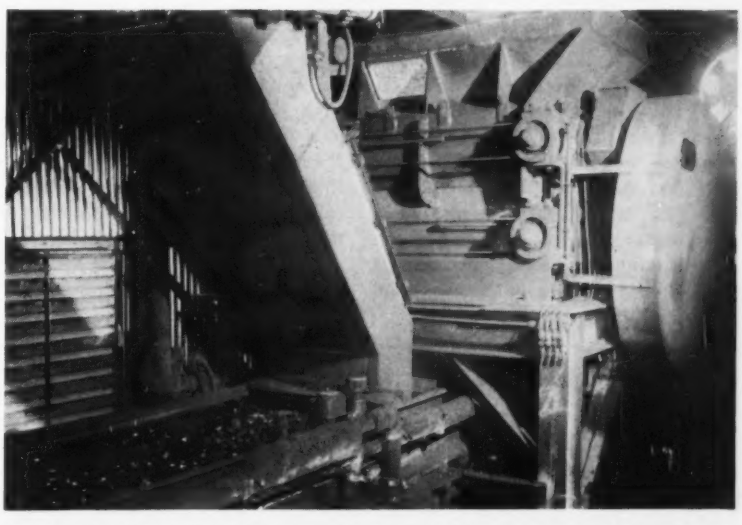
each successive cut will be at a higher elevation than the previous and water will flow by gravity to the main sumps in the old pit.

Stripping Today

Working three shifts per day five days a week, the 16-yd dragline handles an average of 12,000 cu yd of overburden per day in all conditions. And it moves 18,000 cu yd of material per day in the best conditions.

Because of the water-logged nature of much of the overburden, Badgett uses 12x24-ft mats, made of 12x12-in timbers, to provide a solid bearing surface for the 850-ton dragline in first-cut stripping. The company has 12 of these mats which are positioned by one of the company's bulldozers.

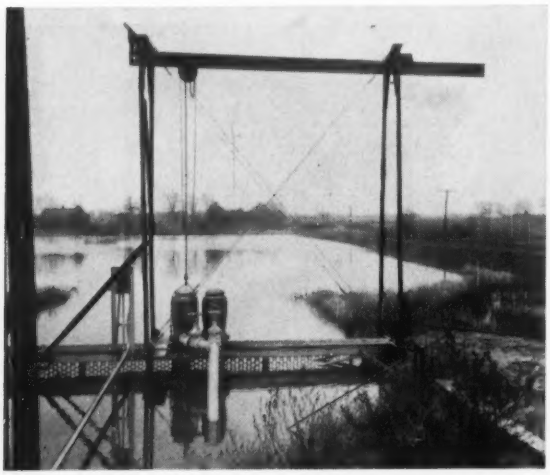
(*Continued on next page*)



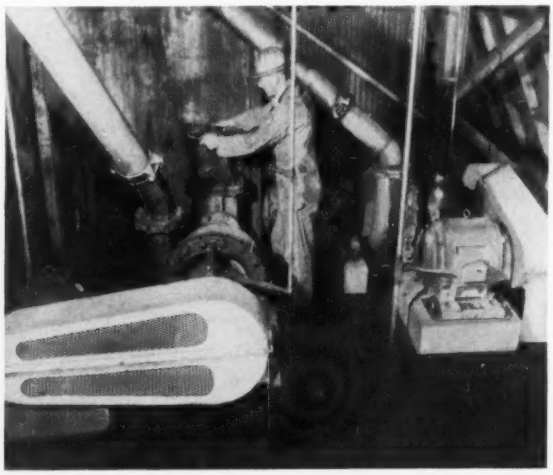
TWO-STAGE CRUSHER is conveniently mounted between upper and lower strands of clean-coal conveyor spanning loading tracks. Resultant returns to conveyor.

ROCK HAULER carries 25- to 30-ton payload to disposal area ½ mi from plant. Unit has blade for leveling refuse pile.

MODIFIED TRUCK TRACTOR, ballasted to bring total weight to 20 tons, simplifies handling of empty and loaded cars.



MAN-MADE LAKE covering 50 acres provides fresh water for preparation plant. Pumps deliver water to plant.



DUPLICATE PUMPS eliminate costly plant downtime and contribute to more effective preventive maintenance.

As the dragline makes the first cut it also reaches over to the next cut and strips off 6 ft of the soft, water-logged dirt. This procedure makes it possible for the exposed surface to dry and harden while the first cut is stripped and loaded. By removing this water-soaked layer as the previous cut is stripped, the company expects to eliminate the need for mats in future cuts.

Drilling and Blasting

Although most of the overburden in first-cut work requires no blasting there are times when a hard 6-ft layer of shale covers the coal. This rock must be broken with explosives.

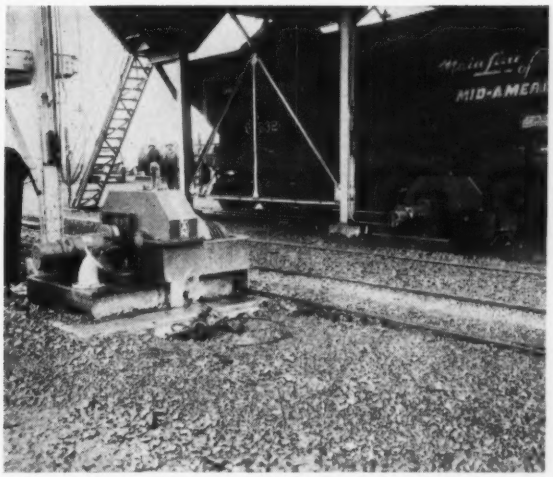
To handle the drilling job, Badgett uses a Joy 225 AQ unit mounted on an International TD24 tractor. Equipped with a Hughes or Williams oilwell-type bit, this unit sinks 6¼-in holes at the corners of 15x15-ft squares. A Worthington 500-cfm compressor, mounted on the front of the tractor and V-belt driven from the tractor's power takeoff, provides air for flushing out drill cuttings.

Two men handle the drilling and blasting job. One man operates the drill while the second man makes primers, loads and stems the holes. In charging the holes, Badgett aims for a ratio of ¾ lb of explosives per cu yd of overburden. If holes are dry, a mixture of Monsanto ammonium nitrate prills and fuel oil is used. One stick of 1⅛x8-in 40% gelatin and a du Pont electric blasting cap serve as a primer. When water seeps into the holes, Badgett switches to 5x25-in cartridges of Austin Apcomite with built-in primers. All charged holes are connected in series and the group is detonated at the end of the shift.

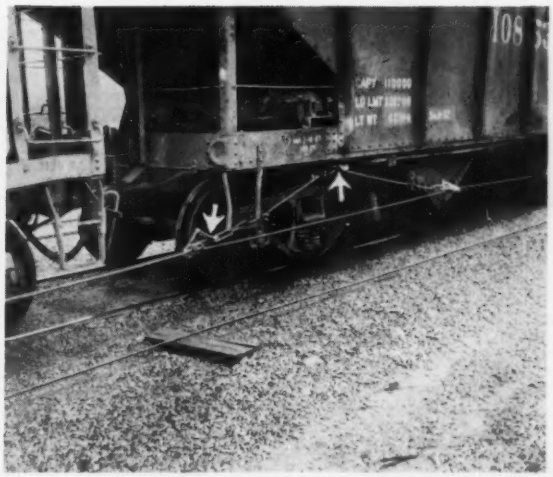
Loading and Hauling

An Allis Chalmers HD21 bulldozer scrapes loose, fine dirt from the top of the coal as the final step in stripping. Then a Bucyrus-Erie 71B diesel-powered shovel equipped with an Esco 5¼-cu yd T-1 steel dipper moves in to load coal into Euclid 25-ton dropbottom trucks.

Badgett has 10 of the trucks avail-



BARGE-TYPE endless-rope hoists enable loading-point operator to move cars in either direction. Ropes extend 600 ft.



CONNECTION of hoist rope to car is by quick-closing clamps on two short pieces of wire rope with hooks.

able for service but most of the time seven units can haul the required tonnage. These seven trucks carry 3,800 tons 1½ mi to a 250-ton storage bin at the preparation plant. Trucks are powered by General Motors 190-hp and Cummins 200-hp engines.

In searching for ways to reduce operating costs, Badgett has experimentally installed 25:00x28 32-ply airplane-type tires on the rear wheels of several trailers. The company reports that the airplane tires have better than 1,000 hr of service and show no appreciable wear. Normal life of conventional tires is about 2,000 hr at Badgett. Management also points out that the cost of the airplane-type tire is less than half of a standard truck unit.

A special adapter makes it possible to mount the larger diameter airplane tire on the regular 21:00x24 truck rim. Air pressure in the 32-ply tire is maintained at 55 lb.

Preparing the Coal

Coal haulers discharge coal into a 250-ton R-O-M bin adjacent to the aluminum clad preparation plant. A reciprocating feeder operated through a Reeves variable-speed drive makes it possible to deliver coal to the plant at rates between 350 and 700 tph. Normal feed is 500 tph.

Raw coal discharges onto a 42-in belt which elevates and conveys it 158 ft to a 9x14-ft Bradford breaker. Traveling 450 fpm, the belt is driven by an Allis-Chalmers 40-hp 440-V motor transmitting power through a Falk speed reducer. The rotary breaker scalps off the large rock and reduces the remainder to a 6-in top size. The 6x0 product falls onto a 36-in belt which carries it to the top of the plant. A Trans-Weigh belt scale weighs the coal as it flows to the plant.

Primary Washing

At the top of the plant the coal flows onto a bar screen that removes 1½x0 for delivery to a 15-ton plant-fuel bin as needed. The remainder of the feed is then sluiced to a two-compartment five-cell Jeffrey Baum-type jig which makes a three-product separation into clean coal, middlings and refuse.

Refuse flows directly to a refuse bin via the jig's elevating conveyor. An E-18 LeTourneau Rocker hauls 25- to 30-ton payloads of refuse to a disposal area ½ mi away. The unit levels refuse with its dozer blade.

Secondary Washing

Middlings pass to an American ring crusher that makes a 1¼x0 product. This crushed product then flows to a sump where an Allis-Chalmers 8x16 WG pump picks it up and delivers it to a Jeffrey two-compartment diaphragm jig that makes a two-product separation into coal and refuse.

Refuse from the secondary washer joins refuse from the primary jig and flows to the rock bin. Clean coal from the secondary washing joins the clean coal from the primary washing.

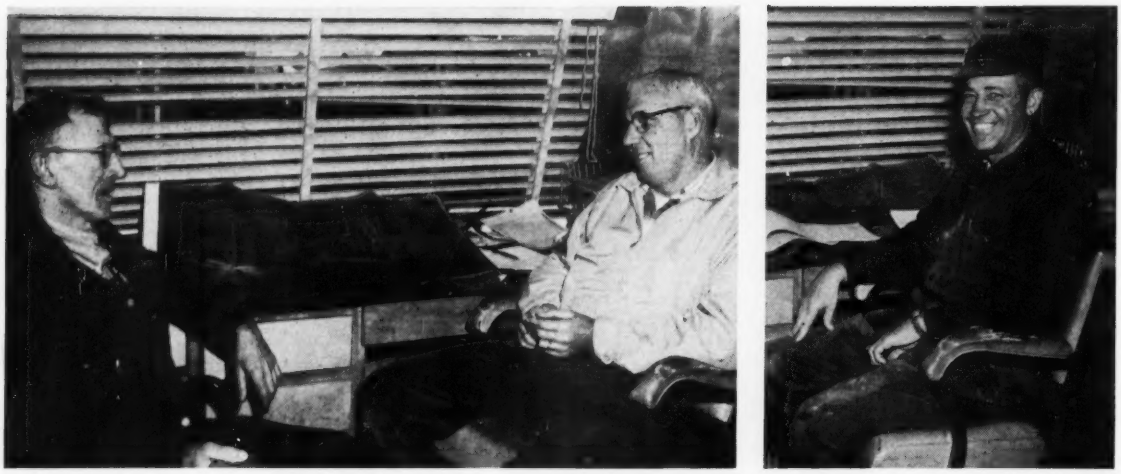
Dewatering and Drying

The combined clean products pass over a Bixby-Zimmer ½-mm fixed sieve and then flow onto a pair of Allis-Chalmers 6x16-ft double-deck Low Head vibrators making a separation into 6x1¼, 1¼x¼ and ¼x0 sizes. The 6x1¼ discharges onto a flight conveyor. This conveyor can discharge the coal on any of the three loading tracks or convey it to a Gundlach two-stage crusher and deliver the resulting product to any of the tracks.

The 1¼x¼ discharges onto a 24-in belt which delivers it either to the No. 2 track or to the bottom strand of the flight conveyor for mixing with other sizes before loading on the No. 1 track.

The ¼x0 from the clean-coal vibrators flows to a drag tank where solids are concentrated before delivery to a sump. Fines then are pumped to a fixed sieve equipped with Bixby-Zimmer ½-mm stainless steel screen before passing to a 6x14-ft Allis-Chalmers Low Head dewatering screen also equipped with ½-mm stainless steel screen.

The ¼x28M overproduct discharges directly into a Bird-Humboldt centrifugal dryer that reduces surface moisture to 5%. Inherent moisture is 6 to 7%; hence the total moisture in the dryer product is 12%. The dryer product drops onto the lower strand of the flight conveyor



SHAMROCK SUPERVISORS include Frank R. Grigg (left), pre paration superintendent; Ross Thomas, general superintendent; and Morton Welborn, assistant superintendent.

handling the larger products and is loaded on Track No. 1.

Underflow from the ¼x28M dewatering screen is pumped to a sludge pond along with the effluent from the centrifugal dryer. Partially clarified water flows to a second settling pond. Clarified water in this pond is reclaimed and pumped to the fresh-water lake. Two Peerless pumps, one serving as a spare, deliver fresh water from the lake to the preparation plant.

All plant controls, supplied by Allis-Chalmers and Cutler-Hammer, are located on the same floor as the two jigs. This arrangement makes it possible for the plant operator to observe both washing units from his pushbutton panelboard.

Oil Treating and Freezeproofing

Badgett has two independent oil-spraying systems for treating the clean coal and preventing freezing in the car. To treat the coal, Badgett employs a Viking hot-oil system. Oil is stored in three insulated and weatherproofed tanks on ground level outside the plant. A Rempe hot-spot unit preheats the 1,000-viscosity oil so it can be readily pumped to the plant. When the oil reaches the plant the Viking system raises the temperature to 190 F. This hot oil then is sprayed on the coal as it falls into the railroad car.

To prevent untreated coal from freezing to the bottom and sides of the car, the company made a spray device for coating the interior of cars with oil. The device has one rotating and two stationary sprays suspended from a common support that can be moved up and down to direct the spray to all parts of the car. The loading point operator controls the flow of oil and the position of the sprays from his booth.

Better Car Handling

Efficient car handling, including weighing, by only two men, as made possible with the aid of a ballasted Euclid truck tractor and endless-rope hoists. The truck tractor is similar to the units pulling the coal haulers and is used to move the empty and loaded cars to and from the loading tracks.

To build up the tractor's total weight to 20 tons, Badgett filled the tires with a solution of calcium chloride and added a ballast tank filled with scrap. With this added weight the tractor can move 12 loaded cars from a standstill on level track.

In normal operation, one man drives the tractor to the empty yard and ties to 10 coupled cars. He then distributes these cars to one or more of the loading tracks and couples them to the last car on the loaded track. Each loading track has its own American barge-mover-type endless-rope hoist to handle the cars under the loading point.

A 600-ft loop of 7/8-in Union wire rope extends from each hoist along each track, with 350 ft of the loop above the loading point and 250 ft below. Rope speed is 20 fpm and hoist pull is 30,000 lb. Railroad cars are connected to hoist ropes by rope and quick-coupling clamps.

As the cars are loaded the second man drops them across the Fairbanks-Morse scales and then notes the car number and weight as printed by the Streeter-Amet automatic weight recorder. After four cars are coupled together below the scale, the tractor unit takes the fifth car to the scale and couples it to the other four. All five cars then are moved to the loaded track. The tractor then returns to the empty track. Badgett management reports that without the aid of the tractor unit it would take six to do the job now done by two.

Only 10 men are needed to process the coal from the time it enters the raw-coal bin to the time the loaded cars come to rest in the load yard. These men are classified as follows: plant superintendent, plant operator, utility man, car loader, two car cleaners, two car handlers, mechanic and sampler.

To simplify plant maintenance, all plant units are lubricated automatically with Texaco products by a Lincoln centralized automatic system. Grease pumps in the main structure are electrically powered while those at the raw-coal feeder and rotary breaker are manually operated. The plant also has a built-in welding circuit with outlets placed so that only 20 ft of cable is needed to reach plant units. Thus in a matter of minutes a man can be ready to start welding.

The offset bearing pin is a special feature of the No. 405 Cincinnati Short Pitch Chain. It eliminates need for keeper pins . . . adds to joint life . . . permits use of sturdier sprockets.

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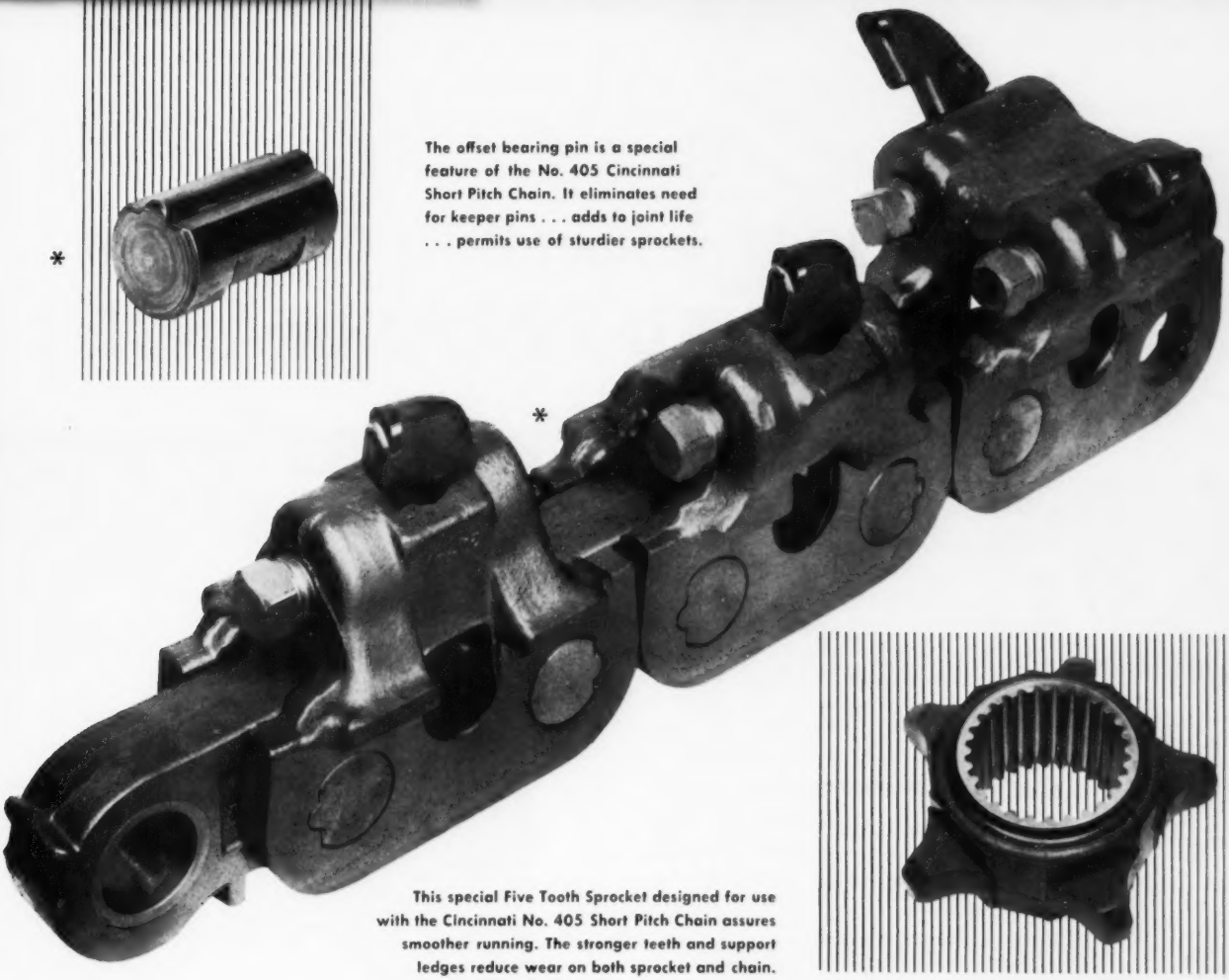

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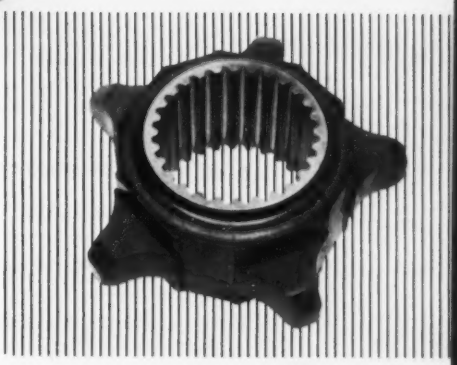

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Included with every shipment of Republic Roof Bolts is a certificate stating specific physical properties of the steel used. Data provided: yield point in pounds per square inch, yield and break point in pounds, and steel heat number. No guesswork about the quality you get from Republic.

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Republic Steel Corporation hereby certifies that the mine roof bolts included in mill order number _____ were made from the following steel:

HEAT NO. | YIELD POINT (PSI) | YIELD POINT (POUNDS) | BREAK POINT (POUNDS)

The above figures are correct as contained in the official records of the Corporation.

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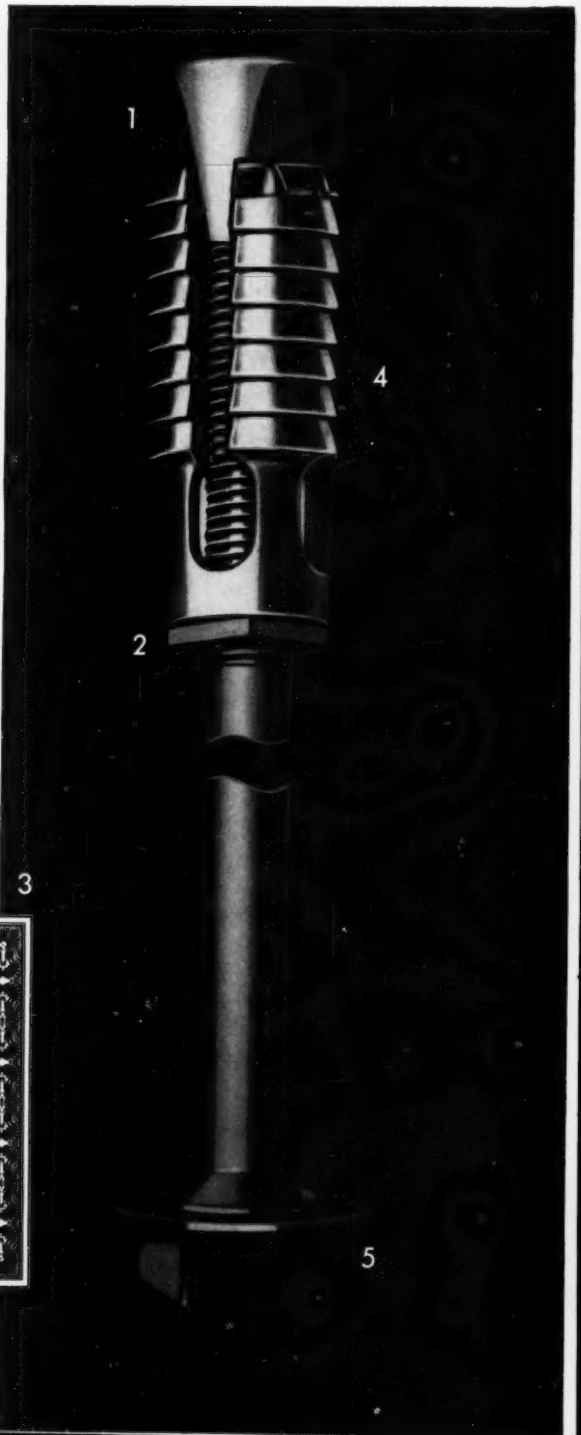

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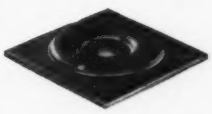

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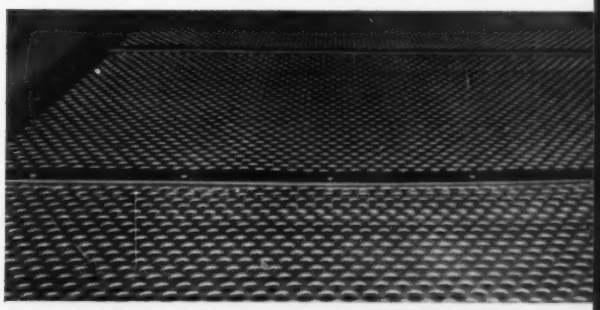

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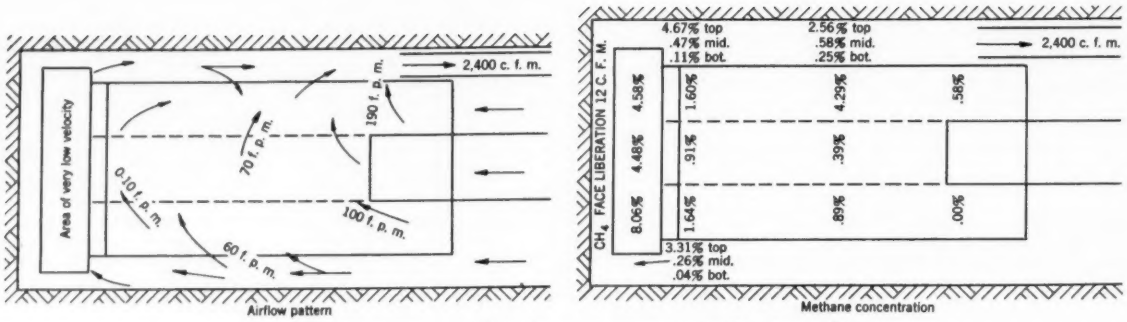

FIG. 1–Flow pattern and methane concentration with exhaust duct.

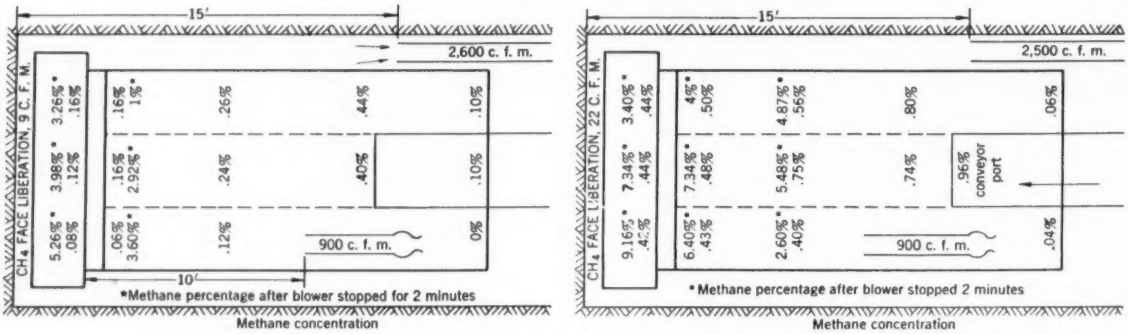

FIG. 2–Small diffuser in conjunction with exhaust duct.

Face Ventilation With Auxiliary Fans

Solving the problem of face ventilation in continuous mining with auxiliary fans and tubing . . . How the various systems compare . . . System installation and maintenance . . . Safety problems . . . Use recommendations

D. S. Kingery
Acting Research Director, Health and Safety Research and Testing, U.S. Bureau of Mines, Pittsburgh.

THE INTRODUCTION of continuous mining has increased tremendously the need for a positive and reliable method of ventilating the immediate face, especially in gaseous seams. When the continuous mining face is advanced at a steady rate the released methane has no chance to disperse, as it does in the cycle of conventional mining units. Therefore, if safety and production are to be maintained an adequate quantity of uninterrupted, high-velocity fresh air must sweep the face while the mining machine is in operation.

Abstracted from a paper at the 1959 annual meeting of the Coal Mining Institute of America.

The potential source of ignition (auger or ripper bits striking some hard foreign matter) will always be present. Thus, the alternative is to keep the methane concentration below the flammable limit. This means that any methane must be diluted as soon as it is liberated from the coal bed or adjacent strata.

Line brattice does a fair job of directing fresh air to the tail of the machine. However, both boring- and ripper-type miners, by their size and operation, restrict side and overhead clearance to such an extent that, in many instances, only a small volume of ventilating air actually reaches the face.

Continuous miners of the boring type, with the cutting head shielding the face, create an area in advance of the machine in which the released methane may be concentrated. Recent tests in the field and in test setups have proved that line brattice often is very ineffective in ventilating the immediate face. Moreover, numerous ignitions have occurred in places assumed to be well ventilated where line brattice was used. These facts stress the need for an uninterrupted high-velocity sweep of air across the front of the machine.

Auxiliary fans with tubing have been used to solve this difficult ventilation problem and, where the fan capacity was adequate, have usually provided satisfactory face ventilation.

Application of Auxiliary Ventilation

The end purpose of any auxiliary ventilation setup is to provide a high-velocity air sweep across the front of the miner to dilute methane lib-

erated by the cutting units and released around the miner head and through the conveyor port. A supplementary requirement is to provide a general diffusion of the air-gas mixture over the miner, thereby eliminating dead areas that permit methane build-up.

Figs. 1, 2 and 3 show the application of exhaust auxiliary ventilation under moderately gassy conditions to a fixed-head type of continuous miner.

Fig. 1 shows the airflow pattern and methane build-up over a continuous miner. The face liberation was measured at 12 cfm of methane. The volume of intake air entering the duct was 2,400 cfm. The end of the duct was approximately 15 ft outby the face.

Analysis of this study reveals the following salient facts:

1. The air velocity at the face was inadequate.

2. Dead spaces were evident, and high concentrations of methane were measured across the face and at both the right and left face rib corner.

3. Although 2,400 cfm of fresh intake air theoretically should dilute 12 cfm of methane to an average of 0.5, little diffusion was evident.

4. Corrective measures appear to be:

a. Maintain the intake end of the duct within 5 ft of the face. Such a requirement would be difficult and would not provide the face velocity required for diffusion.

b. Provide an auxiliary diffusing fan mounted on the miner. Such a diffuser, if of adequate capacity, will entrain the ambient intake air and force it against the face at high velocity.

Fig. 2 shows two studies using a small blower-diffuser operating with an exhaust system. Analysis of these data indicate that the diffuser effectively provided the high-velocity air sweep necessary to dilute liberated methane. With a face liberation of 22 cfm of methane and an intake volume of 2,500 cfm, good diffusion was obtained, and all methane determinations made while using the diffuser appeared to be within safe limits for underground operations.

Fig. 3 shows the effect of a small diffuser discharging across the face and operating with an exhaust duct. An installation of this type provided a good face sweep and good diffusion. The points of high methane concentration were near the bottom and at the conveyor port. Tests made with an auxiliary system operating blowing show equal capabilities. The advantage of a blowing system is that the velocity pressure at discharge frequently will provide adequate face sweep without the diffuser.

Fundamental Considerations

To assure adequate face ventilation and obtain maximum efficiency,

For Safety and Efficiency With Auxiliary Ventilation

1. The size of the fan and tubing should be adequate to provide the necessary air-volume requirements when using the maximum length of tubing or duct that may be necessary.

2. Ducts or tubing should be installed and maintained to prevent excessive leakage and should be suspended from the roof or timbers clear of traffic.

3. Air ducts or tubing ends should be maintained as close to the face as practicable. The suggested minimum distances are:

Exhaust systems, within 10 ft.

Blowing systems, within 20 ft.

4. Each auxiliary fan should be permissible, with enclosed drive and electrical connections, and should be effectively grounded. The fan should be set to minimize fire hazards.

5. Each auxiliary fan should be installed and operated in such a manner that recirculation is avoided.

a. Blowing-type fans should be installed on the intake side of the entry or breakthrough.

b. Exhausting-type fans should be installed on the return side of the entry or breakthrough.

6. The installation and operation of each fan should be supervised and controlled by a competent person responsible to the mine foreman. No fan should be started, stopped, moved or altered except under the supervision of a qualified responsible mine official.

7. The amount of intake air available to the auxiliary fan should be greater than rated capacity of the auxiliary fan.

8. If necessary to prevent intermittent operation, the fan should have a power source separate from other section equipment.

9. Face equipment should not be operated when auxiliary ventilation is stopped and should not be started until the face has been examined by a responsible individual and determined to be safe.

10. Auxiliary fans should be operated continuously during face operations. When a fan is stopped between shifts or because of an extended power failure, line brattice should be installed to prevent a methane concentration at the face.

11. When exhaust systems are used with a small blower or diffuser mounted on the equipment, the machine and diffuser should be stopped immediately if the auxiliary fan stops to prevent the diffuser from recirculating air-gas mixtures at the face.

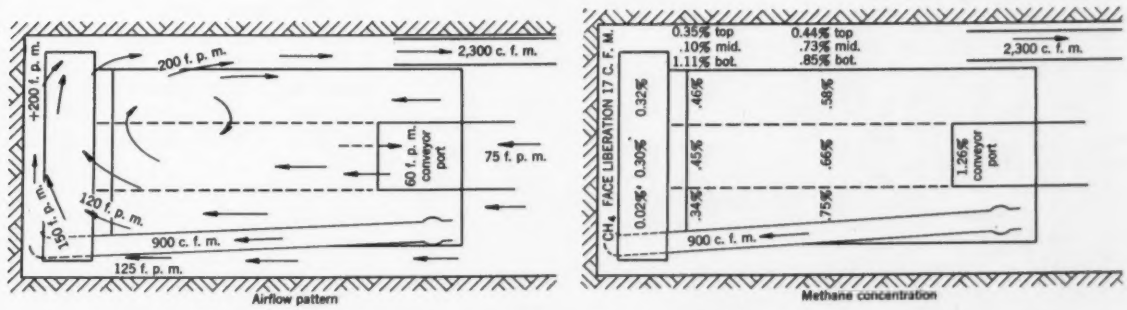

FIG. 3—Exhaust duct in conjunction with small diffuser discharging across the face.

fundamental considerations must be met.

Comparison of Exhaust and Blowing Systems

Blowing System—With a blowing system, intake air at high velocity can be directed against the face or the miner head. If air volume is adequate this high velocity is very effective and provides a good face sweep. The main disadvantage of blowing systems is the dust that goes into suspension and blows back past the machine and shuttle-car operators. Visibility may be poor, and harmful dust concentrations may exist.

Exhaust System—With the exhaust system, the quantity of air available at the face may be sufficient, but unless the duct or tubing is maintained close to the face the velocity will be inadequate to sweep the air across the face. Certain face areas may not be ventilated, and methane concentrations may develop. However, the dust problem at the face is greatly reduced. Dust thrown into suspension is drawn into the duct and discharged into the return air course. Of course, this dust complicates the problem of rock dusting and clean up.

Combined Exhaust and Small-Blower System—Using a small blower in conjunction with the exhaust system provides the advantages of both. The small blower, or diffuser, either separate or mounted on the continuous miner, delivers air at high velocity to the face. The dust entrained with the air is drawn into the exhaust system. The principal disadvantage is that both fans must be operating to make the system truly effective. If the exhaust unit stops for any reason and, by mistake, the equipment continues to work with the diffuser operating, the diffuser can, by recirculation, build up methane concentrations at the face that may be ignited by the mining bits.

The component parts of the system and their importance to efficiency are:

1. The Fan—The air volume induced by the fan will depend upon length, size, type and condition of the resistance of the system. Thus, a fan rated at 6,000 cfm may deliver only 4,000, depending upon the tubing. The air volume desired at the face and the diameter, type and maximum length of tubing comprise the basis for determining necessary fan size.

2. Tubing—Next to the fan the most important component is the tubing. The common type is corrugated flexible tubing reinforced with wire. Such tubing can be used for either blowing or exhausting. However, when exhausting, the tubing must be strong enough to withstand the negative statis pressure produced by the fan or it will collapse.

Tubing diameter is another important consideration. The corrugated tubing commonly used has a much higher resistance factor than the ducts used to establish most manufacturers' listed fan capacities. Moreover, the effective diameter of corrugated tubing is 1 to 2 in less than the rated diameter.

For all practical purposes, the ratio of air quantities at the same pressure drop, for tubing of the same length and comparable installation but different diameters, is:

$$(1) \qquad Q_2 = Q_1 \left(\frac{D_2}{D_1}\right)^3$$

For example, the theoretical difference between 18- and 14-in diameter tubing will be:

$$(2) \quad Q_2 = Q_1 \left(\frac{14}{18}\right)^3 = Q_1 \left(\frac{7}{9}\right)^3$$

$$= Q_1 \left(\frac{343}{729}\right) = Q_1 \times 0.47$$

Approximately one-half the air will be delivered through the 14-in tubing at the same pressure differential.

The accurate formula is:

$$(3) \qquad Q_2 = Q_1 \left(\frac{D_2}{D_1}\right)^{5/2}$$

The exponent, 5/2, is not easy to use, and as no two underground installations are identical the easier-to-use Formula (1) is considered accurate enough for most installations and is within limits of air-volume-measurement errors.

Using the accurate formula, calculated results are:

$$Q_2 = Q_1 \left(\frac{14}{18}\right)^{5/2} = Q_1 (.778)^{5/2}$$

$$= Q_1 \sqrt{.2852} = Q_1 \times 0.53$$

Again, approximately one-half of the quantity will be delivered through 14-in tubing. The ratio of horsepower to tubing diameter for the same quantity of air is:

$$(4) \qquad HP_2 = HP_1 \left(\frac{D_1}{D_2}\right)^5$$

Obviously, to obtain maximum efficiency in the system, the largest tubing practicable should be used.

System Installation and Maintenance—The best fans and tubing will not perform satisfactorily unless the installation is reasonably free from leaks, is properly aligned, and has a minimum of right-angle bends.

With an auxiliary system leakage is very important. When the tubing is under negative pressure each joint or hole will be intaking air to the system. The fan may be delivering its rated volume, but leaks may have taken most of it up ahead of the face. With a blowing system a similar condition may exist. Alignment also is important, as air is moving in the duct at high velocity.

The Diffuser—The purpose of the small blower mounted on the machine is to entrain intake air delivered by the auxiliary fan and deliver it at high velocity to the face.

The ratio of diffuser capacity to incoming air is important. A diffuser that is too small, although better than none, will not entrain enough air. This is especially true in ultragassy mines where methane liberations may be 100 cfm or more.

Where large volumes of intake air are needed to dilute heavy gas emissions, the most-effective diffuser capacity generally is about one-third to one-fourth that of the intake air. The ratio will vary somewhat with the available clearance.

The principles outlined are fundamental to an efficient auxiliary ventilating system. Most of the systems studied are operating satisfactorily, and single fans are delivering 2,500 to 4,000 cfm of fresh air to the working face. Usually this volume is adequate for moderately gassy mines. However, in ultragassy mines, where the methane liberation varies widely, experience has shown that at times more than one auxiliary fan and tubing installation is required, and that even then numerous production stops are necessary to clear away methane.

The problem of fan size is determined by several factors, the most important being expected methane face emissions. The minimum amount of fresh air required at the face to dilute methane to 1% is 100 times the emission, and this minimum presupposes perfect diffusion, which is never obtained. Thus, for a face liberating 100 cfm of methane, 10,000 cfm of intake air must be available—not at

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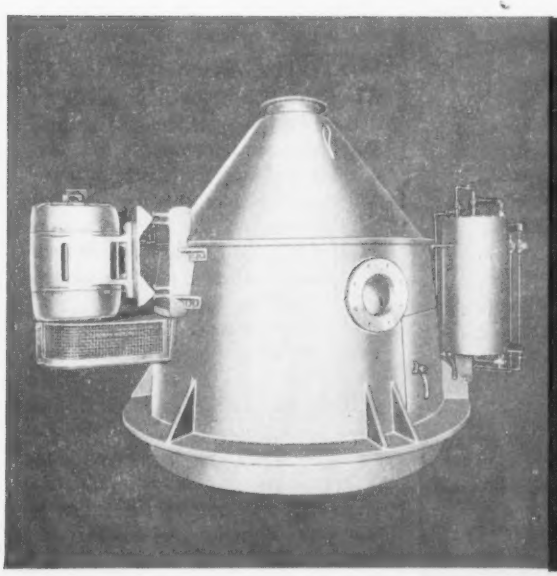

LISTED ABOVE ARE ONLY A FEW OF THE HUNDREDS OF FIRMS WHICH HAVE ONE OR MORE CMI DRYERS IN CONSTANT OPERATION. THESE COMPANIES ARE ENJOYING THE LOWEST POWER CONSUMPTION COST — LOWEST MAINTENANCE COST — LOWEST "PER TON" COST.

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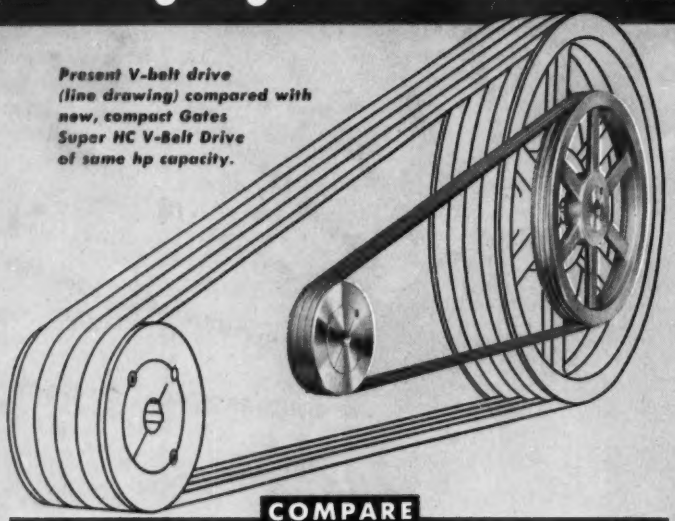
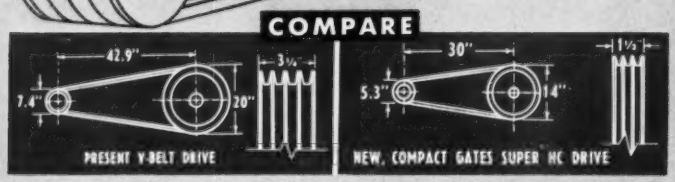
Designing NEW DRIVES?



Present V-belt drive (line drawing) compared with new, compact Gates Super HC V-Belt Drive of same hp capacity.



Save up to 20%

with new high capacity V-belt drive

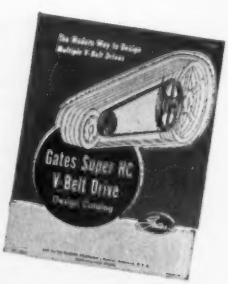
When you change the whole drive — both V-belts and sheaves — remember: The cost of a Gates Super HC V-Belt Drive is as much as 20% less than the cost of present V-belt drives of the same horsepower capacity.

A development of Specialized Research in the world's largest V-belt laboratories at Gates, the new Super HC V-Belt makes possible the most compact, lightest-weight, lowest-cost multiple V-belt drive you can put on any machine!

Cuts drive space as much as 50%

With Gates new Super HC V-Belt, sheave diameters and widths can be reduced 30% to 50%, center distances 20% and more. Bearing load is lightened and total space occupied by the drive may be cut as much as 50%.

"The Modern Way to Design Multiple V-Belt Drives" is an informative handbook on the Super HC Drive, available from your nearby Gates Distributor listed in the Yellow Pages of your phone book.



The Gates Rubber Co., Denver, Colorado
Gates Rubber of Canada Ltd., Brantford, Ont.
World's Largest Maker of V-Belts

TPA 439

Gates SUPER HC V-BELT Drives

the fan but at the face. With normal leakage losses of 25% for a good installation, the fan must deliver 12,500 cfm. Where the methane liberation varies between entries or from time to time, it frequently is more advantageous to use two or more fans rather than a single high-pressure installation requiring heavy tubing.

The pressure requirements for auxiliary ventilation systems warrant a brief review. With large air volumes the system pressure the fan must overcome is terrific, and special heavy-duty tubing is required. For example, the approximate pressures required to induce the following air volumes through 200 ft of 14-in corrugated tubing with two bends are:

CFM	Inches Water
5,000	7
10,000	27
20,000	108

Obviously, for large air volumes large tubing must be provided or more than one tube must be used.

Safety Problems

The most important hazards associated with auxiliary ventilation are:

1. Recirculation—This hazard becomes minor if the fan is properly installed, enough intake air passes by the fan, and adequate air volumes are available to the diffuser.

2. Ignition Sources – This hazard can be reduced by requiring permissible standards for all electrical connections, grounding of the fan and any metal ducts, and an installation that is not a potential fire hazard.

3. Methane Build-Up at the Face When the Fan Stops—This condition is the most serious potential hazard. Any prolonged fan stoppage in a gassy mine will cause methane to accumulate at the face. This requires that (a) everyone on the section understand the hazard; (b) no equipment be operated when the fan is down; (c) the face be kept clear of methane by line brattice during fan stoppages; (d) examinations be made regularly; (e) the face be clear before starting the fan after a stoppage. These requirements necessitate a standard operating procedure with definite responsibilities assigned when starting, stopping, moving, or in any way changing the auxiliary-fan installation.

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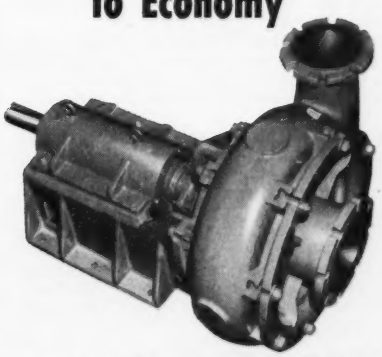
Wherever Sustained Pumping Performance is the Key to Economy



Type CK Solids Pump. A heavy duty, low speed solids pump with extra wide clearance, designed especially to handle fluids containing random size solids and heavily abrasive materials.

If you are pumping coal tailings or any random size solids, there is a Morris Pump that will do the job dependably and economically.

Because they are often located in inaccessible areas where service needs must be few and far between, Morris pumps are designed to operate at highest efficiency, *constantly*. Morris pump reliability is based on quality features developed during 95 years of hydraulic design and testing experience.

Field testing has evolved the most exacting engineering of component parts . . . the correct selection, forming and machining of just the right alloys for each application . . . and pumps that are rugged, long-wearing and trouble free. Every part of every Morris Pump is accessible for fast, routine service—holding preventive maintenance to a minimum.

Let the qualified Morris Representative in your area help you select the right Pump for your job. Representatives in principal cities or write direct.

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When you're talking about a $162,000 dipper shovel, you've got to talk about the best rope for it

Talking about or working with, the same thing applies. Anything below Royal Blue's performance level is simply unrealistic. Like looking for a cut-price brain surgeon.

Even at $162,000, the cost of wire rope is important. That's why so-so ropes can cost you more in the long run, because so-so ropes are *short run*. Royal Blue, on the other hand, is built by America's oldest manufacturer of wire rope to last, to do the job without a whimper. Here's why.

Royal Blue is made from the toughest rope wire ever made—Type 1105—extra high-strength improved plow steel. This pedigree gives to the rope qualities that you can't find in any other rope: exceptional resistance to shock, abrasion, fatigue and impact. Add to these a flexibility that age cannot wither nor hustling fade and you've got a collection of characteristics that make Royal Blue the strongest rope you've ever used.

A $162,000 Dipper Shovel deserves the best and your Roebling Distributor has it . . . Royal Blue. Any inquiries about this high-born rope will be answered immediately by Roebling's Wire Rope Division, Trenton 2, New Jersey.

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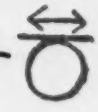
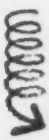
Branch Offices in Principal Cities

John A. Roebling's Sons Division • The Colorado Fuel and Iron Corporation

If it rolls on an axle or turns in a bearing or rides on a shaft  if it slides in a groove or moves on a pivot if it bores  or cuts or transmits pressure one of Sinclair's 500 specialized lubricants is designed to make it work better. For answers to your lubrication problems, write today to

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Sinclair

Foremen's Forum

A Coal Mine Is Hazardous?

Yes, but the hazards away from the job should give us a jolt because they greatly affect on-the-job safety. Read on . . .

OUR HOMES are wired with electricity right into our soaking-wet bathrooms. Many of the circuits are ungrounded even though motorized appliances may be plugged into any of the outlets. It's enough to make a mining man shudder. The 21-in picture tube in the TV set is a potential bomb, requiring only the misdirected toss of Junior's toy to set off a glass-strewing implosion. Safer away from work? Read on.

Most of us employ a high-pressure vessel of one sort or another in our basements to supply heat for our homes. A malfunction in the boiler of that heating unit could have disastrous consequences. And get this, gas is piped into many homes while the coal mines go to great lengths to sweep it out.

Many of us live in homes having only one exit from upper floors in direct negation of all common-sense rules of fire safety. How many of our homes are properly equipped with fire extinguishers? In operating condition? Even more appalling, a number of our schools are short on recommended safeguards for maximum fire safety.

Operating a powered lawn mower is somewhat like standing beside the bar of a cutting machine while it sumps in. You've got to keep your mind on what you're doing, and it's no place for children.

Safer away from work? Read on.

Every person driving an automobile has a tankful of a potentially lethal gasoline about 4 ft to his rear, and about 2 ft ahead, under the hood, is a source of ignition deliberately installed there. That's not all. Underneath the floor of the vehicle is a sadly neglected tube, the exhaust system, carrying a stream of deadly carbon monoxide.

Two cars traveling at 60 mph in opposite directions pass each other at 120 mph, often only a few feet apart. Furthermore, each is traveling on four pressure vessels, the tires. Safety is a prime consideration in the design of all components of a car, but once the owner gets his hands on the vehicle the responsibility for its maintenance is his alone.

Annually the automobile is employed in transporting groups of men to far places where the men unlimber high-powered rifles in search of game. What gamblers we are! Driving and hunting should make us realize how much we really depend upon the other fellow for our own safety when we are away from work. It seems to us that there is a more genuine concern underground for the welfare of others. We have seen it demonstrated.

There are other transportation hazards aside from those on the highways. Not so very long ago a passenger train approaching New York ran off a bridge while the lift span was raised to permit the passage of ships. This is something that could not possibly happen, but it did. During 1959, two young, enterprising strip-mine operators from Pennsylvania were killed in separate crashes of private airplanes.

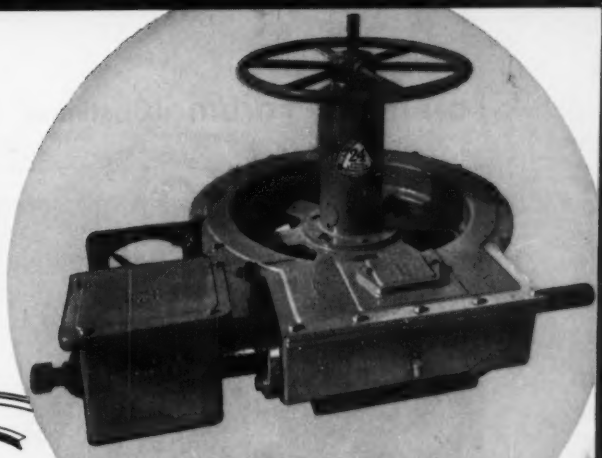
Are you really safer away from work? In a number of industries the frequency rates for off-the-job accidents are less favorable that the frequency rates for accidents in those industries. Don't forget, hours of exposure to off-the-job accidents greatly exceed hours of exposure at work. Week ends and holidays make a real big difference.

If a man is injured at work he suffers a loss of wages but not a total collapse of family finances. Compensation or salary continuation will be of help. However, an off-the-job injury may completely wipe out family income and disastrously increase family outgo. Safety consciousness away from work is of utmost importance.

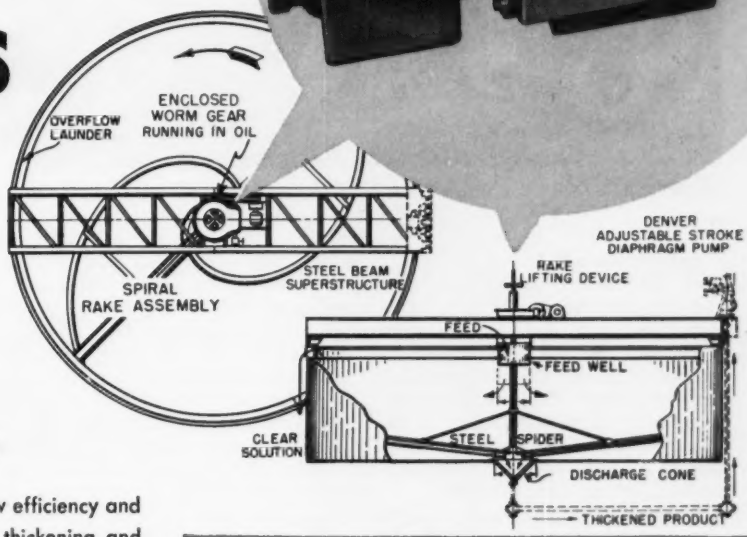
(*Continued on next page*)

DENVER

Spiral Rake THICKENERS



✓ Simple
✓ Low Cost



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- Simple, effective overload indicator plus rake lifting device, either manual or automatic, to avoid damage or lost production from overloads.
- Spiral rakes move settled solids to center discharge port in only one revolution. Other types of rakes available to suit operation. Rubber covered or stainless steel shaft and rakes for acid or corrosive applications.

Before you buy a thickener... use
DENVER TESTING SERVICE to determine correct thickener size for your needs.

Laboratory tests, conducted at no cost to you, supply reliable data on

(a) Settling Rates **(d) Thickener Unit Area**
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These tests can assist you by eliminating risk of specifying a thickener that's too small to do the job or too large and costly for your needs. Ship 5 gallon slurry sample prepaid to

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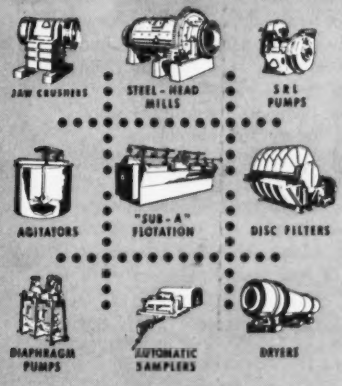
No Cost to You for This Test Service!



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TOTAL SAFETY CONSCIOUSNESS, on the job and away from work, is mighty important.

Perhaps you could work into one of your "Five-Minute Safety Talks" with your crew a reference to this very important matter of off-the-job safety. You might make the point that the hazards mentioned in the foregoing discussion represent natural hazards, somewhat comparable to those faced in mining. The situation can be immeasurably aggravated if faulty personal safety habits are brought into these conditions.

If you want to be of greater help to your men you can make the point that most accidents nowadays result from a combination of (1) natural conditions, (2) poor maintenance of equipment, including autos and household equipment, and (3) bad personal habits. We have already discussed the first of these three factors. Let's look into equipment maintenance as it applies away from work.

When we mention poor housekeeping we are not casting aspersions at the lady of the house. She may keep the place as clean as the proverbial pin, but a small rug on a highly-polished floor can throw unsuspecting folks into a bad fall. (Don't be fussy about these matters, just make suggestions, especially if she is a good cook.) However, safety maintenance at home is a man's job primarily. The ways and means are fairly well known. Wiring should be adequate, and gang plugs at convenience outlets should be ruled out wherever possible. Spare fuses should be kept at hand; pennies under fuses are absolutely forbidden, of course.

Furnace and flue should be cleaned periodically and the water-supply system to the boiler should be carefully watched. Auxiliary heaters and fans should be well guarded. Step ladders must be kept sturdy. The release mechanism on the wringer of the clothes washer must be operating properly. Was it tested recently? Does the lady of the house know how to use it?

Are half-empty paint cans and turpentine containers accumulating on the basement shelves? Has the family made plans for leaving upper floors in case of fire? One fellow we heard of has fastened rope ladders to strong hooks in the walls of the childrens' bedrooms. They can toss the free end of a ladder out of a nearby window and come down in safety, if necessary. Think about this: Is it wise to quarter an infant in an upstairs room, away from the instant grasp of his parents?

U. S. Steel safety officials say in their program, "Knowing's Not Enough." We must do the things we know how to do.

THIS DISPLAY should be posted on bulletin boards throughout your mine during the month of March, if you are participating in the nationwide 1960 campaign to reduce the frequency of roof-fall injuries. You can purchase kits of these materials at nominal prices from C. H. Hoch, National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

This extends to maintenance of automobiles, hand and power tools, toys and even the trees on our properties. Maintenance of physical property, therefore, is one avenue by which we may offset the accident-producing potential of the natural conditions under which we live, at or away from work.

Another avenue of approach is through training people in proper "living habits" for safety, a concept similar to training in proper work habits for on-the-job safety. This includes providing information on the steps to be taken in the event an emergency arises at home or on the highway. Most people know, but they must be reminded.

Some folks invariably set a pan of water to boiling on the stove with the handle of the pan projecting over the edge of the stove, where passersby can hook it—or toddlers can take hold to see what is in the pan. A safety-conscious workman, who has been reminded of these possibilities by his supervisor, can correct unsafe habits like this one. Others see nothing wrong with leaving the caps off containers of volatile, flammable liquids as long as the job requiring their use proceeds. The hazards are obvious, if people think about them.

Does your young lad know how to inflate his bicycle tires at the service station? Does he know their proper inflation pressure? Does he know the hazards of overinflation, including tire bursts. Your workmen also have young bike riders, and this lesson, taught now, may remain when they become auto drivers.

You can see that there are infinite possibilities for dispensing lessons and information in off-the-job safety. Why is it worthwhile for you to do so? Perhaps one of the biggest reasons is that total safety consciousness at all hours of the day and under all conditions will tend to increase safety consciousness of employees at work.

Furthermore, off-the-job accidents can scramble your crew assignments as thoroughly as on-the-job accidents. The cost to industry of off-the-job accidents for this reason alone must be astronomical. More and more managers and supervisors are becoming aware of this fact. As time passes you will hear more and more of industry's concern for and stake in off-the-job safety.

This management interest in total health and safety for employees is a public and humanitarian service, and that is worthwhile.

If you as a suprevisor will give thought to these benefits you will see compelling reasons for taking an active interest in the safety of your men away from work.

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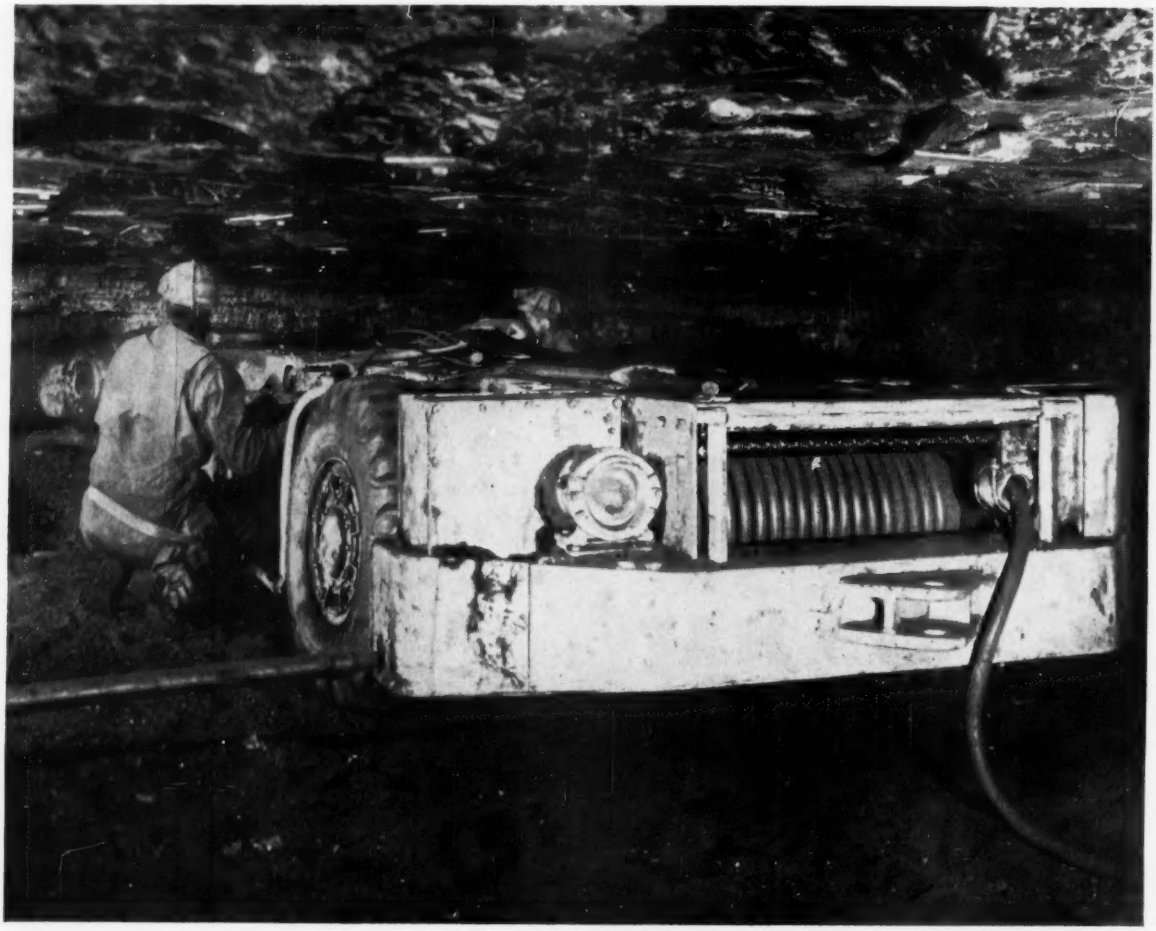

HEAT:

What are the limitations of your trailing cable?

Reel up layer-on-layer of trailing cable on a mining machine and heat can become a really serious problem . . . especially in the inner layers where it can't be dissipated quickly.

Some cable jacketing materials can't take heat. They soften. They get squeezed out of shape and take a permanent set. They frequently lose their tensile strength, resilience and their ability to withstand abrasion and impact.

Not neoprene synthetic rubber. It retains its unusual combination of properties at temperatures as high as 250° F.... will work satisfactorily if the temperature occasionally goes even higher. Combined with its resistance to acid water, oil, grease and physical abuse, this makes neoprene your surest cable jacketing investment. Remember, all of its properties have been *proved* through 25 years of electrical service. E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Department, Wilmington 98, Delaware.

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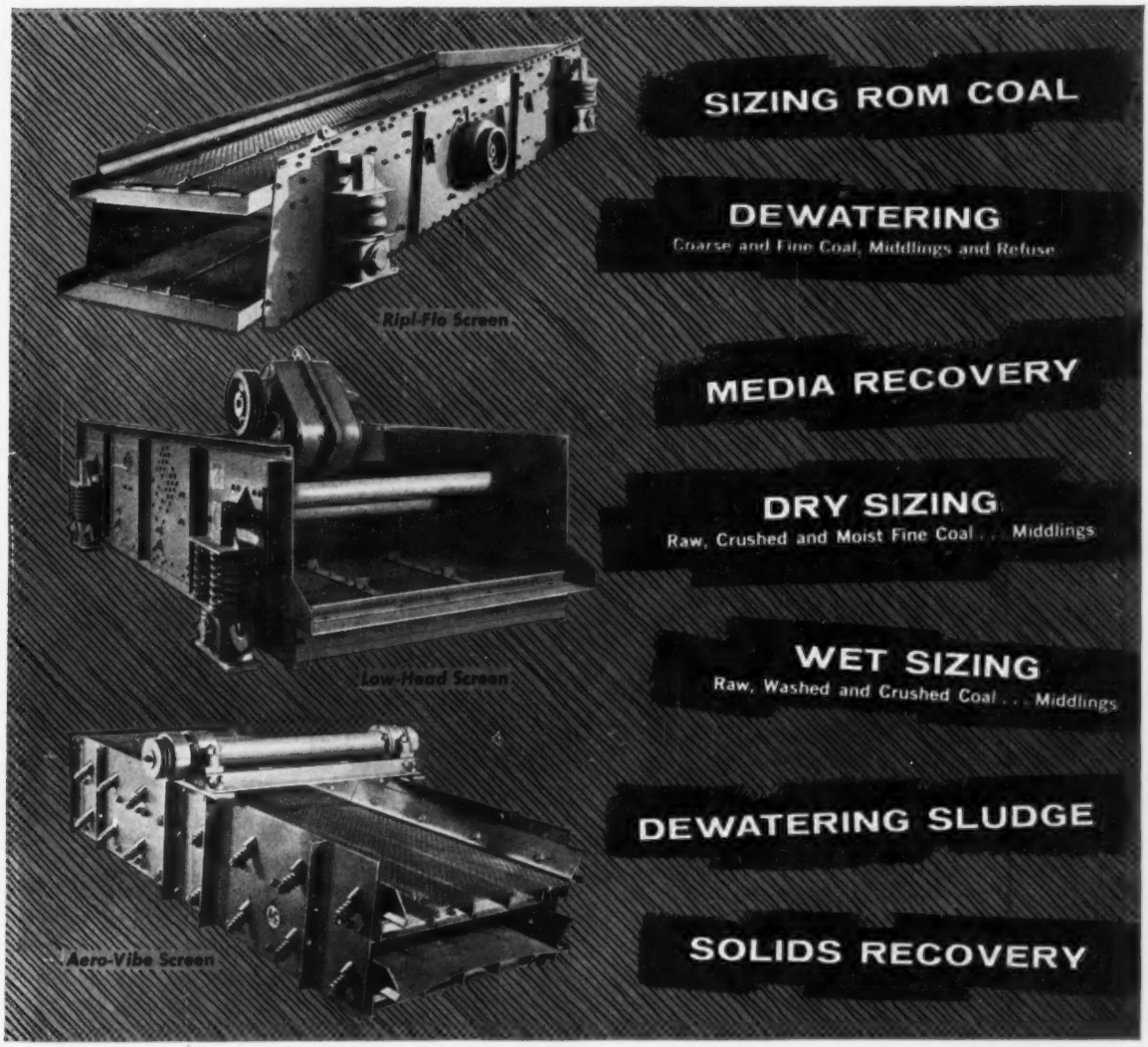


Whatever your need . . . Allis-Chalmers can provide the exact vibrating screen your coal process requires!

For applications in ROM screening, sizing, dewatering, and media recovery, Allis-Chalmers has a complete line of standard units up to 8 by 20 feet . . . screens which have been use-tested and proved at coal preparation plants in all areas of the world. The quality of A-C screens, the satisfaction of users account for the fact that *more A-C screens are used by the coal industry* than screens of any other manufacturer.

A helpful screen selection guide has been prepared to help you choose the right model for your process. Contact your Allis-Chalmers representative or write for Bulletin 25B6280. Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

Aero-Vibe, Low-Head and Ripl-Flo are Allis-Chalmers trademarks.

ALLIS-CHALMERS

A-1201

Operating Ideas

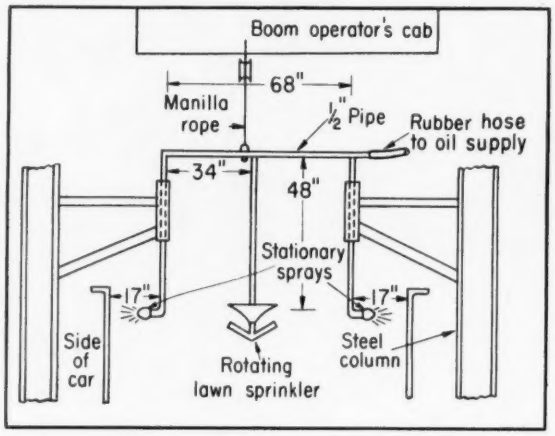
Low-Cost Oil Spray System Freezeproofs Cars

A LOW-COST spraying system developed by Badgett Mine Stripping Corp., Providence, Ky. coats the interior of railroad cars with oil and prevents coal from freezing to the sides and bottom as it travels to the customer. The system includes one rotating and two stationary sprays which are moved up and down by the loading boom operator to coat the car's interior with oil as it moves under the loading point.

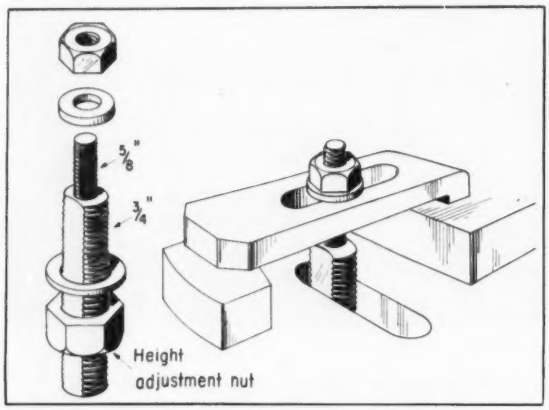
All three sprays are suspended from a common 68-in feed pipe which connects to a rubber hose leading to the oil supply. The two stationary sprays are 17 in from the two sides of the car and the rotating spray is in the center.

A section of manila rope leads from the feed pipe to a series of pulleys and then into the operator's booth where it terminates at a triangular-shaped piece of ½-in round rod. The operator uses this triangular rod to raise or lower the sprays with his foot. He also may drop the triangular rod over a steel bar at the back of the booth to hold the sprays above the end of the car. When he lowers the sprays again he can stop them in any position or let them go down a full 48 in, which lets the feed pipe rest on the support brackets.

To get full oil coverage on the bottom of the car, the company hit on the idea of using a simple rotating-type lawn sprinkler. Attached to the center feed pipe with the base up, the lawn sprinkler has proved to be a low-cost, effective oil spray. The two stationary sprays are standard units used for treating coal.



Badgett's car-coating system operates independently of the plant's hot-oil system which is used to treat coal as it flows into railroad cars.



Special Bolt for Easier Strap Clamping

A SPECIAL two-diameter bolt helps ease the job when you do strap clamping on platens or slotted tables, writes Charles H. Willey, Penacook, N. H. The bolt he uses not only has two different sizes but also has two flat edges on the larger end to keep it from turning in the slot.

Once the lower section of the bolt is positioned with the nut and washer to give the desired height to the section above the table, only the top nut need be tightened to secure the work. Another advantage, Mr. Willey notes, is that only the nut and a very short section of the screw extended above the strap. This advantage is desirable in any setup work.

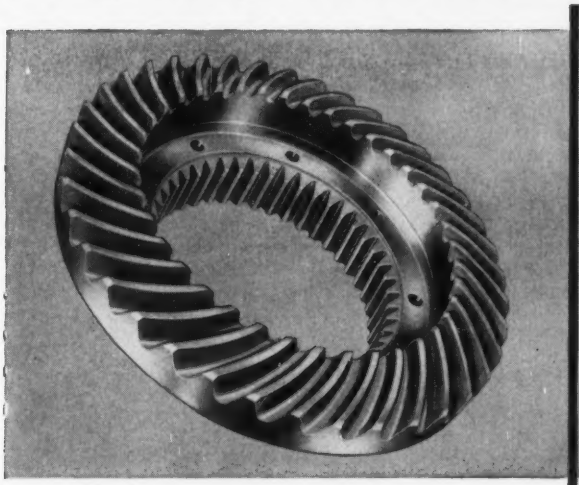
Electronic Surveying Speeds Mine Mapping

A RADAR-LIKE distance-measuring instrument called the Tellurometer is now being used by Aerial Map Service Co., Pittsburgh, Pa., to pinpoint precisely the location of air shafts, to run exchange lines and to establish other horizontal controls for mapping.

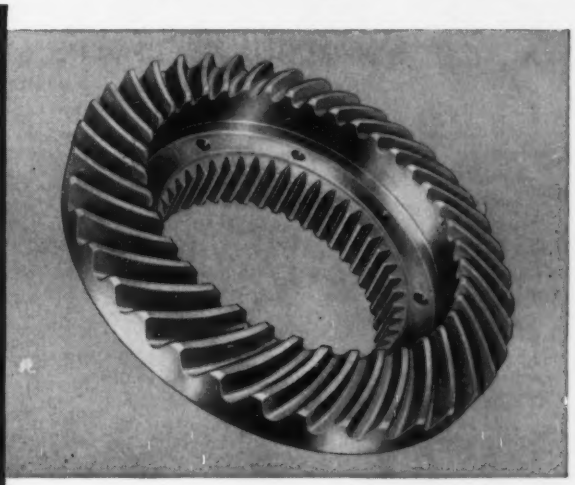
A prominent coal company of Pittsburgh recenty asked Aerial map Service to use the surveying technique to determine exactly the surface location of a proposed vertical air shaft. The job required running a line from inside the mine to known points about 2 mi on the surface and then running it back over the mountainous surface to locate the precise point where the air shaft should be sunk.

Preliminary location of the proposed shaft was done by traditional methods; however, this work was done through very rough terrain in winter. As a result, the engineer in charge felt that it was necessary to check this work. With drill crews and equipment already on location, it was essential that this work be performed as quickly as possible. At the request of the coal company, the mapping firm brought in one of the new electronic Tellurometers and re-ran the lines on the surface.

They May Look Alike . . . but they're Not!



Replacement Ring-Gear
Made by Eaton—Axle Division



Replacement Ring-Gear
Not Made by Eaton

Only Genuine Eaton Axle Service Parts are Identical to the Original Production Components

Even Eaton Axle parts may wear out and require replacement. When this happens it is important that repairs be made with Genuine Eaton Axle Service Parts. They are identical to the original production components in design, metallurgy, heat treatment, and quality of finish—made to run together with the other axle parts. Eaton replacement parts are held to the rigid quality standards established for axle components and will deliver the same dependable, low-cost kind of service. So when, after thousands of miles of trouble-free operation, it may become necessary to replace worn parts in an Eaton Axle, it's most economical to make these replacements with Genuine Eaton Axle Service Parts.

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AXLES

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Although it was winter, with snow and bad weather, they came up with a precise location in four days.

The Tellurometer, which measures the distance between two points by means of microwaves, requires only two men to operate. Impulses are sent from a transmitter to a receiver and back. The time they take to make the round trip is easily converted into miles, feet and inches. The system is capable of measuring to an accuracy of three parts in one million. Mapping crews need only 30 min to set up their gear, measure a line and dismantle.

The Tellurometer system has been used widely to survey route locations for new highways, for pipelines and transmission lines, but the work in Pennsylvania is believed to be the first application of the new instrument to the surveying needs of mining companies. Aerial Map Service, which specializes in mapping for mining companies, also used the Tellurometer to run a 26-mi exchange line between the Emerald Land Co. and the Consolidation Coal Co. in Washington, Pa. On another assignment for the latter company, the instrument was used to establish 42 traverse or triangulation stations for precise location of 100 boreholes.

In West Virginia the surveyors ran a reconnaissance survey of nearly 200 sq mi for Tasa Coal Co. to determine the overburden ration of a stripping operation. Maps from the survey accurately located the seam outstrip and depicted the overburden by contours.

Good Welding Grounds Prevent Machine Damage

DURING arc welding a heavy electric current passes from the arc welding generator through cables to the metal being welded. It then jumps across a gap, melts the metal electrode and returns to the generator. The path of the electric current traveling from the ground clamp through a tractor, engine or other piece of equipment to the point where the arc occurs is very important.

According to the service department of Caterpillar Tractor Co., an arc is likely to occur wherever a gap interrupts the flow of current. The heavy welding current may also break up and take numerous paths through a machine on which welding is being performed. Should the current encounter an air gap across a bearing in the engine, it is possible for welding to take place right there. Although fusion of the two pieces may not take place, weld blotches on a bearing or gear can cause an early failure of the part, simply because the ground connection of the arc welder was not properly placed. Arcs have been known to occur in the transmission when the welding was being done on the front end.

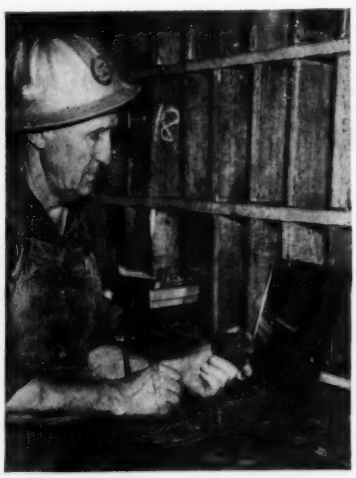
The paths taken by the return current to a welding generator are unpredictable. The only certain thing about electric current is that it will travel the route of least resistance. For this reason it is best to fasten a ground clamp directly to the piece being welded. If this is impractical, take extra care to give the return current the least chance of going astray. Give the return current a short, direct path and stray currents won't damage other parts of the machine.

Shop-Made Mirror Simplifies Lamp Checking

HERE'S AN EASY WAY developed by Jack King, superintendent, Laddie Coal & Mining Co., Robbins, Tenn., to check whether the switch on a cap lamp is functioning properly. Mr. King suggested that the lampman shine each lamp at a reflective surface rather than look directly at the burning lamp to check if both filaments might be burning. Since a regular mirror reflects too much light and therefore was not much better than looking directly into a lamp, Mr. King suggested painting one side of a piece of window glass with flat black paint. The result was a surface that provided the desired reflection when a lamp was pointed at the unpainted side.

The lampman now points a burning lamp at the painted glass and sees at a glance whether one or two filaments are lit. If both are burning, the glow of the two filaments can be seen distinctly. When the lampman previously looked directly at a burning lamp he had difficulty in seeing whether both were lit.

As a side benefit of the shop-made reflector, management notes that there are fewer complaints about lamps growing dim toward the end of the shift. In the past this dimming resulted from both filaments burning at the same time and draining the battery at a faster rate. Now this trouble is spotted and remedied as part of routine daily servicing.



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DOWTY . . . world pioneers and leaders in hydraulic roof control . . . has developed the ROOFMASTER, *fully mechanised support system* for longwall mining.

With application of the ROOFMASTER, *all functions of roof control* on a 600-ft. longwall face may be performed with two men. Results: greater production, greater *profits*, greater *safety*.

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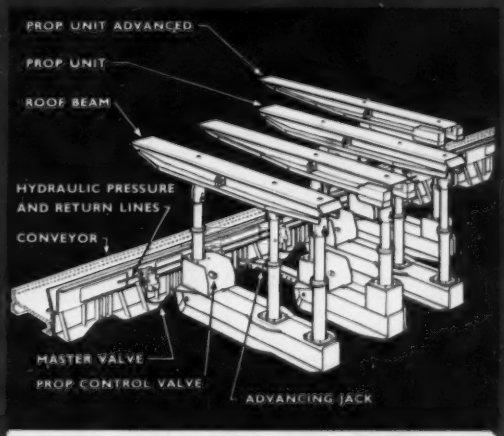
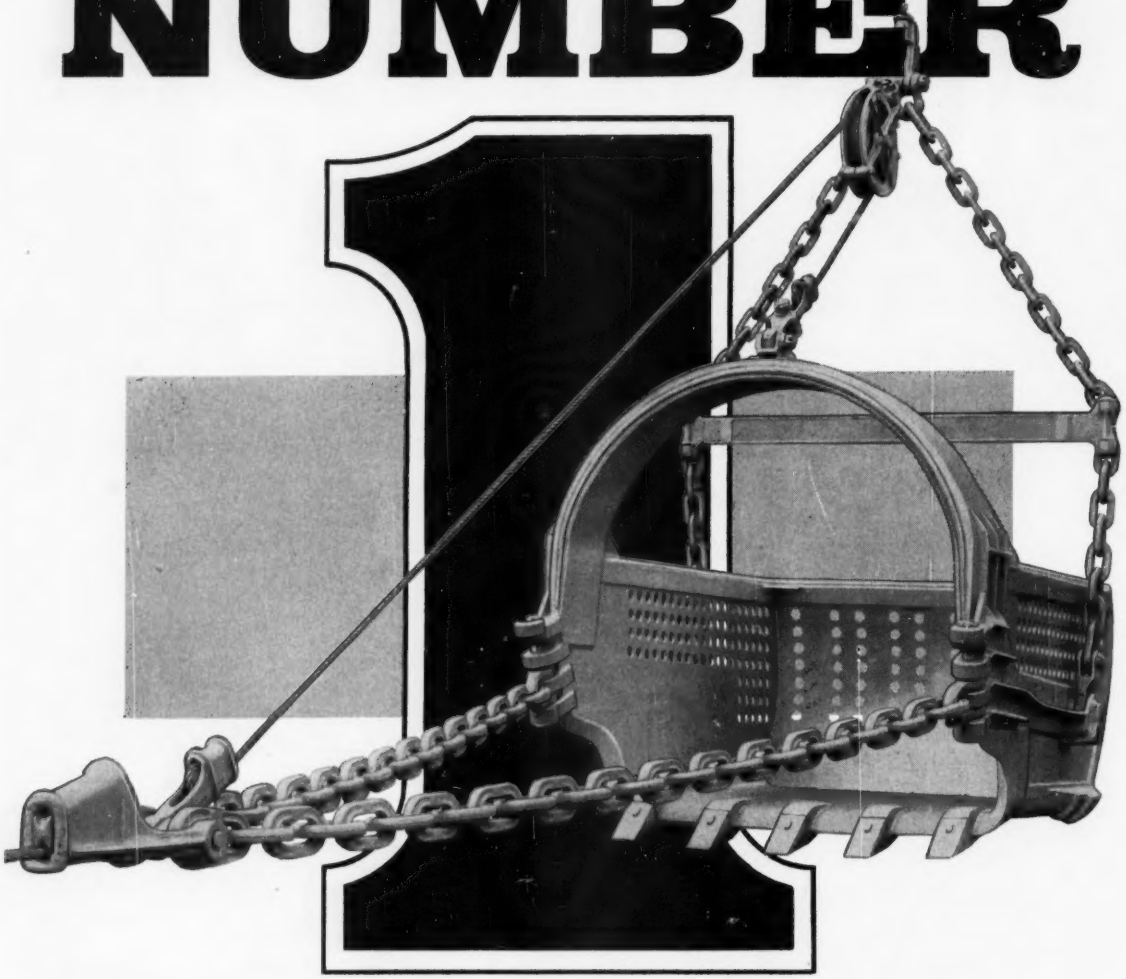
world pioneers of hydraulic roof control



The ROOFMASTER

The DOWTY *Roofmaster* consists of self-advancing, hydraulic-powered support frames. Only two men required for continuous operation of 200 support frames. A daily advance of 15 ft. on a 600 ft. longwall retreating face would provide a daily output up to 2,000 tons with a total crew of 20 men.

NUMBER 1



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4½ to 14 Cubic Yards With or Without Perforations

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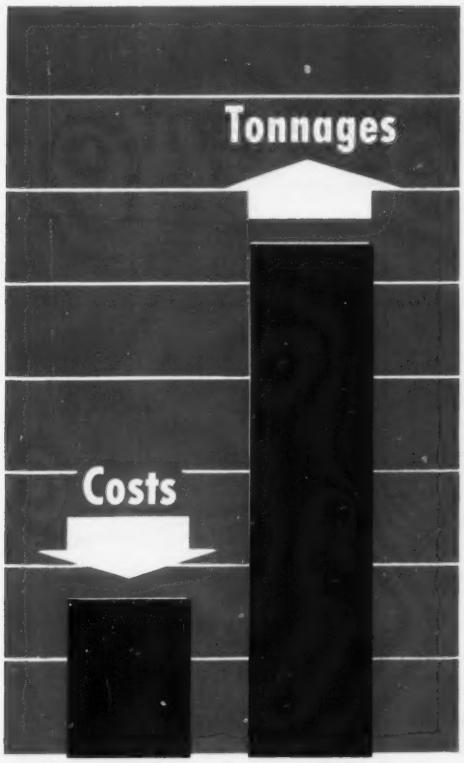
Hendrix DRAGLINE BUCKETS



Lower Pumping Costs...Higher Tonnages

Wilfley's versatile line of sand pumps give you economy plus increased output. If you require belt-driven,overhead V-belt driven, or direct driven pumps, Wilfley has them —available in 1″, 1½″, 2″, 2½″, 3″, 4″, 5″, 6″, 8″ and 10″ discharge sizes. They may be fitted with interchangeable electric furnace alloy iron, special application alloys or rubber-covered wear parts.

Put a Wilfley Sand Pump to work—it guarantees continuous, maintenance-free service, stepped-up production, longer pump life, and quick, easy replacement of parts.

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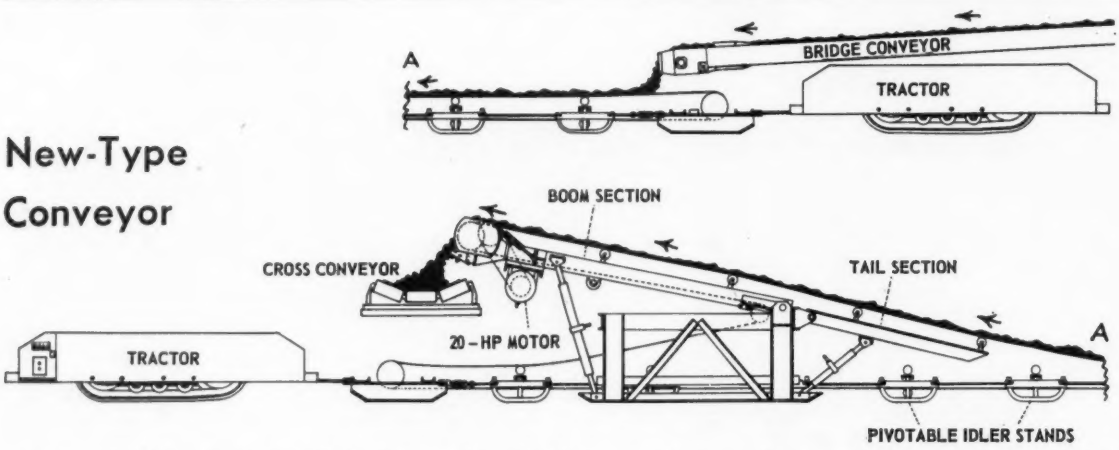
WILFLEY

SAND PUMPS

COAL AGE

Equipment Developments

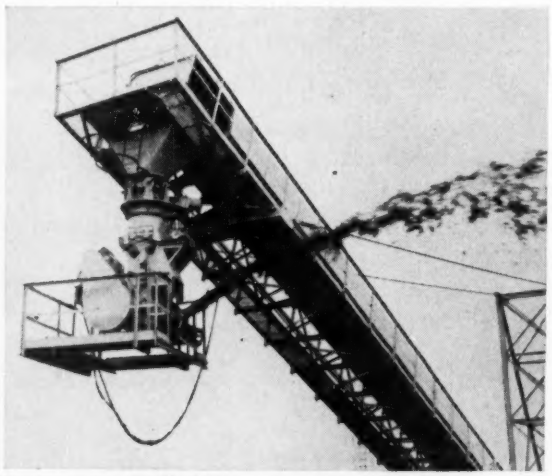
New-Type Conveyor



A new extensible mine conveyor that can operate up to a week or more without being moved is being marketed by Hewitt-Robins, Inc., Stamford, Conn. The machine, comprised of a belt that rides idlers mounted on sled-like skids at 5-ft intervals, reduces "down-time" in underground mining, compared to conventional conveyors, which must be moved often to keep pace with continuous mining machinery, says the company. The new conveyor may be constructed with as many as 200 skids, making a unit 1,000 ft long. The equipment is located behind the mine loader, which receives material from the continous miner. A traveling tripper permits variation in the distance from the conveyor loading point to the discharge area. Material can be handled at a rate of 400 tph for 70 hr or more without moving the machinery. When the mine face is beyond the conveyor system's limit, tractors tow the entire unit in long sections to a new work area. The electro-hydraulic crawler tractors, which exert tension at each end of the conveyor, can be used for various hauling and lifting jobs in the mine.

More Power

The machine pictured above is the "work-styled" D6 Series B tractor, now available from Caterpillar Tractor Co., Peoria, Ill., and incorporating major improvements resulting in greater efficiency, according to the firm. The company has also announced a new model D4 Series C tractor, which is rated at 52 drawbar horsepower and is said to provide 25% more lugging ability than previous models. Among the major new features of the D6 are: a completely new compact engine providing greater lugging power; two new hydraulic control units, now integrally mounted; and a tilt cylinder for special applications. The engine delivers 93 flywheel hp at 1,600 rpm. An all-new operator's compartment is more efficient and comfortable, notes the firm. The D4 is available with either standard or optional lower-speed transmission and is the first in its size class to have a forward-reverse lever, according to Caterpillar. The new spur gear transmission has five speeds forward and four in reverse, and a new air cleaner is reportedly 99.8% efficient under all conditions. The D4 has a four-cylinder engine delivering 65 flywheel-hp at 1,600 rpm.



Increased Storage

When handling coal or other small-lump bulk materials, the Swivel-Piler, developed by Stephens-Adamson Mfg. Co., Aurora, Ill., increased conveyor storage range up to 10 times. When mounted on the discharge end of a storage conveyor, the unit will throw material in any direction over an arc of 270 deg. This feature eliminates frequent shifts of the storage conveyor system, saving time, equipment and money, declares the

40 INSTALLATIONS in 15 COUNTRIES

THE DUTCH STATE MINES HEAVY MEDIUM CYCLONE WASHER

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With a Dutch State Mines Heavy Medium Cyclone Washing System, you get, from Roberts & Schaefer, these exclusive benefits: The technical knowledge of Dutch States Mines engineers, their experience with successfully operating plants in many countries, and the continuing collaboration of their technical organization with the R & S staff on installations in the United States.

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The first commercial Heavy Medium Cyclone Washing Plant in this country, engineered and built by Roberts & Schaefer, is now in operation and others will come on stream in coming weeks.

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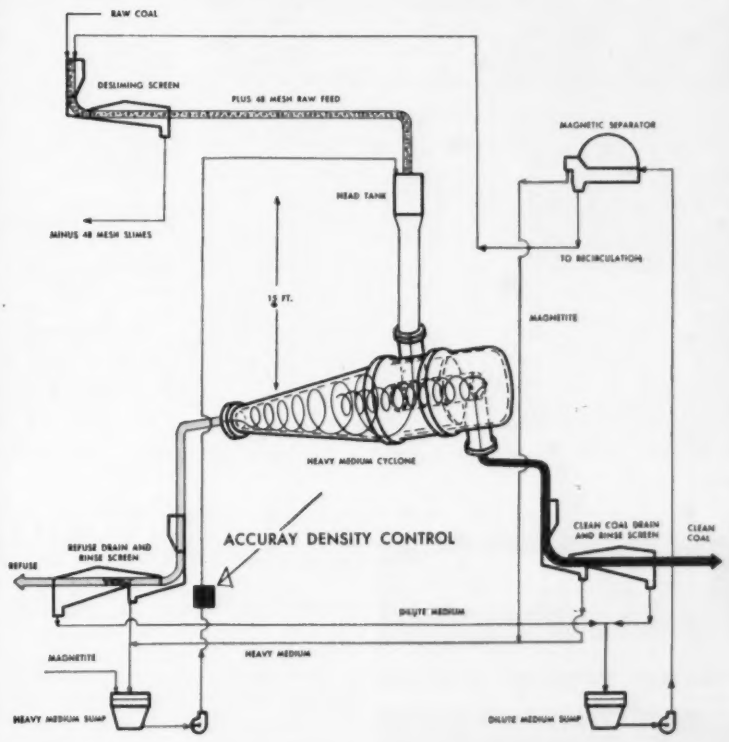
FLOW DIAGRAM OF HEAVY MEDIUM CYCLONE WASHING SYSTEM



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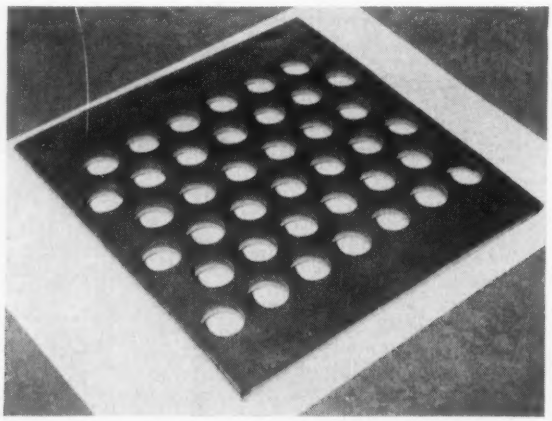
DIVISION OF THOMPSON-STARRETT COMPANY, INC.

firm. The S-A Swivel-Piler, consisting of a centrifugal thrower unit with hopper and swivel-joint, can be mounted as a unit beneath the discharge end of practically any portable or fixed belt conveyor. Trajectory of material can be raised or lowered from 8 to 40 deg by means of an operating adjusting level. The device is available in 10-in and 16-in wide belt sizes.

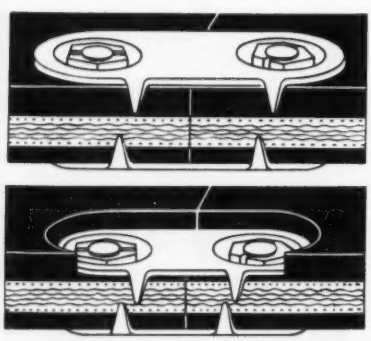
Scraper Unit

A new 3½-yd scraper unit to be mounted on Caterpillar motor graders has been designed by Martin Co., Kewanee, Ill. The unit is mounted in place of the blade and circle on Caterpillar Nos. 112, 12 and 14 graders, using grader power and existing connecting points to permit fast loading and unloading of most materials, says the manufacturer. "GradescrapeR" is said to be the first scraper unit that can be tilted to one side to scrape ditch sides while the grader remains level. Once loaded, it can be lifted up with the mechanical drive of the grader and carried at full highway speed to the dump area. Road clearance is 11 in fully loaded. The scraper features replaceable abrasion-resistant cutting edges. Box-section construction is used throughout for tough rigid resistance to wear and damage. An apron opening of 19½ in provides plenty of clearance for large chunks of earth or stone.



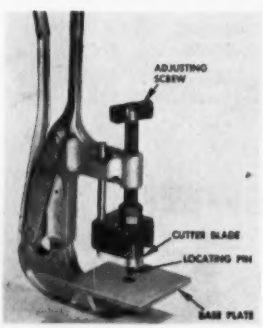
Rubberized Screens

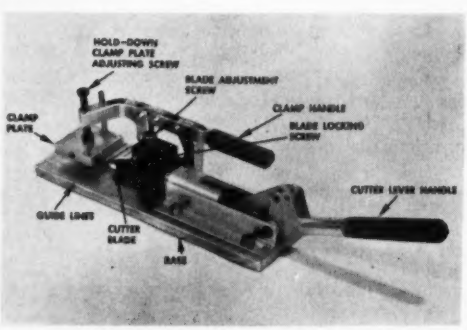
Perforated steel screens with rubber coverings are available from Hendrick Mfg. Co., Carbondale, Pa. The screens, which come in sizes up to ½-in steel thickness and ¾-in rubber covering, are said to be long wearing and abrasion resistant because of their rubberized finish. This durability results in lowered cost of screening per ton of coal, declares the firm. Hendrick reports that its screens handled mineral-bearing sand for as much as 5 mo. This is almost 4 times as long as standard screens, which wore out in 5 weeks, states the manufacturer.



Countersinking Tools For Belt Fasteners

Flexible Steel Lacing Co., 4607 Lexington St., Chicago 44, Ill., manufacturer of Flexco belt fasteners, has announced the availability of newly-designed equipment for countersinking their fasteners into heavy conveyor-belt covers (3/16 in and over). Explaining the advantages of countersinking fasteners, the company notes that on heavy rubber covers Flexco teeth cannot penetrate very far into the load-carrying fibers of the belt. Plates are exposed to abnormal wear from abrasive materials and scrapers and rollers may be interfered with by fasteners protruding above the belt surface. Solution of the problem with the new countersinking equipment is demonstrated in the figure at the top left. Here some of the cover has been cut away to permit the Flexco teeth to penetrate the belt carcass, thus affording maximum joint strength. The manufacturer reports that countersinking of the plates permits clean scraper operation, lengthens fastener life, eliminates noise on return idlers and minimizes abrasive wear on idler bearings. It also cuts down the overall thickness of the belt at the joint, facilitating use of a smaller size Flexco fastener. Splice life is thereby increased because belt flexing at the joint is minimized. The two tools (left) required for the countersinking operation hold the belt rigid for ease of operation. The tools make vertical and horizontal cuts necessary for sinking the fasteners.





(Continued on p 162)

B.F.Goodrich

These B.F.Goodrich tires help haul 200,000 tons of coal a month

THIS unit is one of a fleet that hauls 200,000 tons of coal a month out of a strip mine in Ohio. Ahead is an 8-mile trip to the dump on a road made of shale and crushed rock. Payloads run to 50 tons and over. For this rugged work, the company uses B.F.Goodrich Rock Service tires.

Now you get even longer service from Rock Service tires, thanks to 2 amazing new B.F.Goodrich compounds. Only B.F.Goodrich builds tires that are actually *tailor-made* for your type of work.

For jobs where rock cutting and chipping are problems, B.F.Goodrich developed the Cut Protected compound. For jobs with dangerous heat build-up, B.F.Goodrich developed the new Heat Resistant compound. These new tires, and the regular Rock Service, have the B.F.Goodrich FLEX-RITE NYLON cord body that withstands double the impact of ordinary materials. Result: You get more retreadable tires—more retreads per tire.

Get the Rock Service tailor-made for you from your B.F.Goodrich Smileage dealer. He's listed under Tires in the Yellow Pages of your phone book. *The B.F.Goodrich Company, Akron 18, Ohio.*

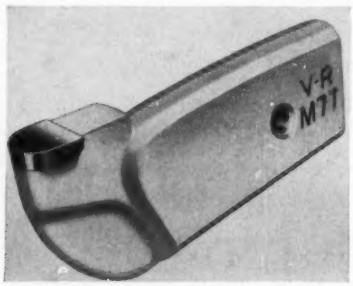
Specify B.F.Goodrich Tubeless or tube-type tires when ordering new equipment

Smileage!

B.F.Goodrich *off-the-road tires*

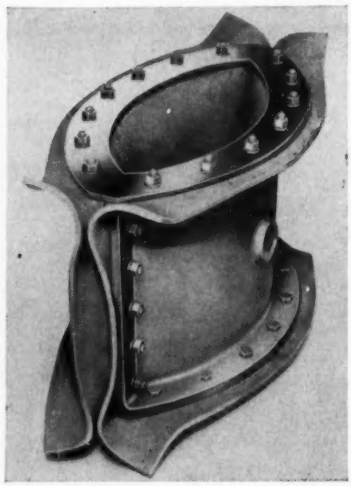
Equipment Developments (Continued)

NYLON BELT—A conveyor belt made of heavy nylon yarn is a new prod ct at Russell Mfg. Co., Middletown, Conn. The space between the yarns is filled with specially compounded polyvinyl chloride plastic. The nylon-plastic combination produces a light-weight, high-strength, fire-resistant material which is said to outperform conventional rubber conveyor belting wherever it is used. The company believes the non-corrosive, non-tearing belts with great abrasive resistance are ideally suited for coal conveying.

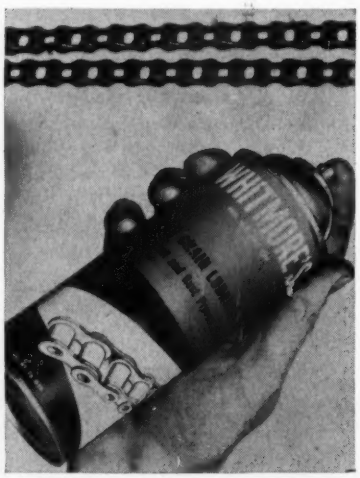


CUTTER BIT—A new-style chain cutter bit for auger miners is being marketed by Vascoloy-Ramet Corp., Waukegan, Ill. Known as style M7T, this addition to the V-R Red Bit line provides double-locking security by combining the holding power of a taper-type shank and a retainer pin. The cut-away nose shape reduces drag and regrinding time to a minimum.

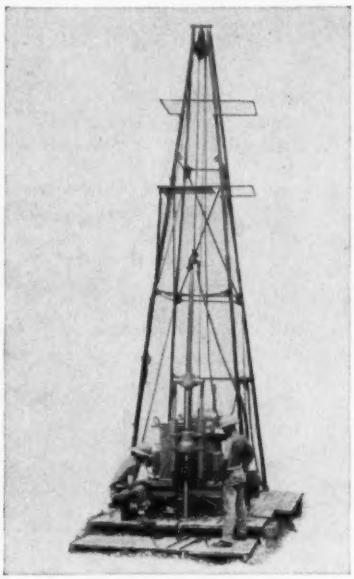
NEW TRACTOR—An 11,000-lb. capacity rubber-tired tractor shovel has been introduced by Pettibone Mulliken Corp., Chicago, Ill. Designated Model PM-440, it is the largest in a completely new line of Speedall tractor shovels now being produced by the firm. Lift capacity is 21,000 lb and breakout force 24,800. Bucket rollback at ground level is 40 deg while clearance under the bucket hinge pin is 11 ft 10 in. Wide-base high-flotation tires are supplied as standard equipment.



DISCHARGE VALVE—A new rubber-diaphragm peristaltic-type discharge valve which makes it possible to handle coarse abrasives such as catalysts, pellets and other odd-shaped materials unable to pass through conventional rotary valves, is now available from the U. S. Hoffman Machinery Corp., New York 3. The valve's elliptical body and "sandwiching" of its sheet-rubber diaphragms insure positive closure. Movement is confined to the rubber diaphragms which open and close by air pressure or vacuum. This action permits discharge of materials in measured quantities with 100% air-tight seal. Should either of the rubber diaphragms rupture, the other diaphragm is capable of extending to the opposite side of the valve for complete and positive closure, making it "fail-safe," according to the firm.



CHAIN SPRAY—A free aerosol can of a lubricant for increasing the life of open chains is available to interested companies from The Whitmore Mfg. Co., Cleveland 4, Ohio. Whitmore's open-chain lubricant, now packaged in this 16-oz aerosol can, is a penetrant, lubricant and rust-preventive to lengthen open chain life up to 300%, according to the firm. Fast and easy to apply, the lubricant was developed to work into close-tolerance, internal friction surfaces of open chains and between bushings and pins and bushings and rollers to reduce wear and dissipate heat.



NEW CORE DRILL—The new Presidente core drill made by Acker Drill Co., Scranton, Pa., has a 4,500-ft capacity with an AX (2-in) bit and features a hydraulic drill head and new patented automatic chuck. The firm reports the drill is adaptable to skid-or truck-mounting with diesel, gasoline or power-take-off drive. A power-operated air brake and clutch are features not previously included on drills of this capacity.

AIR CLEANER—An oil bath air filter with a pneumatic oil lift and no moving parts has been introduced by American Air Filter Co., Louisville, Ky. This redesigned Model C P01 Cycoil brings the industry, in one unit, the advantages of an automatic self-cleaning air cleaner with high efficiency and low maintenance, says the company. Cost of installation has been reduced and simplified and the new filter features a pneumatic lift for easy lifting of oil from the reservoir to the perforated oil distribution plate, which in turn distributes oil to the pads.

(*Continued on p 164*)

windproof... with Ashland **Permatreat** Coal Spray Oil!

***Stop losing coal cash* because of tonnage that's gone with the wind!**
Spray your coal and the top of the car with Permatreat, and it becomes Windproof . . . Dustproof . . . and Non-Corrosive. It resists freezing. You eliminate frozen car pockets.

***plus* — REFINERY-CONTROLLED QUALITY.**
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***plus* — TECHNICAL & RESEARCH SERVICE.**
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***plus* — CONVENIENT SUPPLY POINTS.**
Large storage facilities located near the coal fields guarantee you dependable delivery of Permatreat . . . by tank car or transport truck.

ONE **Permatreat**MENT LASTS THE LIFE OF THE COAL!

For immediate service call any of these convenient Ashland Oil offices.

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Louisville, Ky., SPring 6-4631
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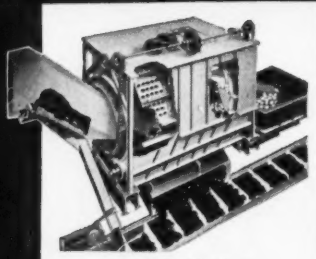
Ashland PERMATREAT

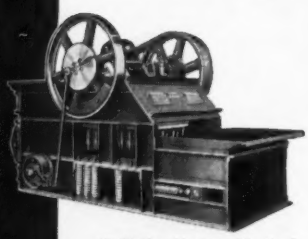
ASHLAND OIL & REFINING COMPANY, Ashland, Kentucky

America's most complete line of CRUSHING EQUIPMENT



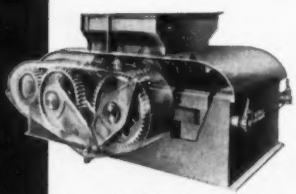
McNally Pittsburg Rotary Breaker

This unit allows positive control of top size in handling run-of-mine washery feed. Production of fines is held to a minimum.



McNally Norton Vertical Pick Breaker

50% Less fines when reducing lump to egg and stove sizes.

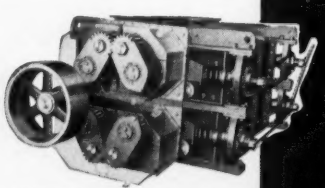


McNally Double Roll Gearmatic ROM Breaker

Built in tonnage ranges from 750 tph to 1400 tph. Full floating gearmatic drive.

McNally Gearmatic Stoker Coal Crusher

This unit offers three prime advantages: high volume production, plus accurate sizing, plus low percentage of fines.



McNally Two Stage Crusher

This unit consists of a double roll primary crusher mounted above a double roll secondary crusher—compactly arranged into a single rigid structure.

Available From Stock and on Short Delivery

For immediate action on complete information write, wire, or call

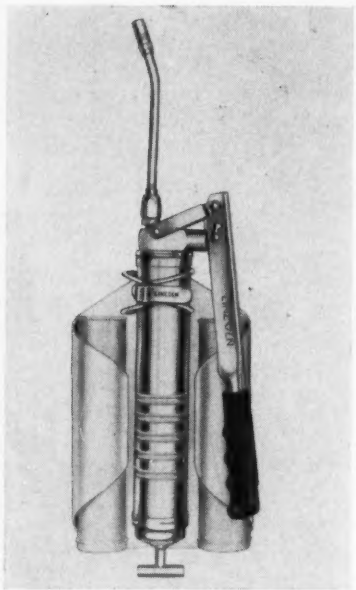
McNALLY PITTSBURG MFG. CORP.

Pittsburg, Kansas Wellston, Ohio

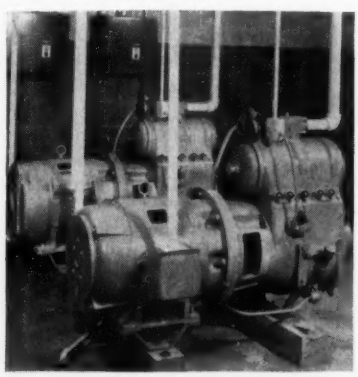
Equipment News (*Continued*)

NEW BIT—A cutter bit with a new design has been anounced by Kennametal Inc., Latrobe, Pa. The new U17 bit features the gage shoulder at the front of the bit instead of the back. The knock-out shoulder of the U17 has been moved to the back. Cross-sectional area of the new bit shank—with dimensions increased to $\frac{5}{8}$x$\frac{1}{8}$ in—is about 40% larger than that of conventional ½x1-in shanks. Wear on bit blocks is less because the bit is held more firmly and rigidly in the block, says the firm. Cutting action is improved and harmful shock is minimized by rigid block support. The bit, available with three standard tip styles—cylindrical plug, reversed, and full-nose radius open-face—are changed faster and easier with the knock-out shoulder in the new position. The U 17 is designed to replace the U14 in holders, using steel pin in neoprene cyclinder as keeper.

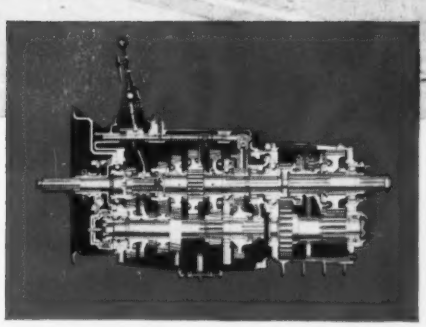
PROTECT TUBING—To prevent rupture of polyvinyl chloride, polyethylene and nylon soft plastic tubing when used with brass or steel fitting connections, The Weatherhead Co., Fort Wayne, Ind., has introduced a plastic tubing insert available in both brass and stainless steel. Inserts come in seven sizes for use with plastic tube sizes from ¼ to $\frac{5}{8}$ in with 1/16-in wall; ¾ in size with 3/32-in wall; and 1-in size with ⅛-in wall.



GREASE GUN—A lever-type grease gun that provides either high pressure or volume delivery of lubricant by use of a simple shifting device has been developed by Lincoln Engineering Co., St. Louis. The all-steel gun, with a rust-resistant nickel finish, has a nozzle extension that swivels 360 deg, permitting easy access to hard-to-reach fittings. It can be loaded with a standard 14½-oz grease cartridge, a Lincoln filler pump, or by suction. To change pressure all you do is shift the latch pin in the handle from one slot to another. Lincoln states that pressures up to 10,000 psi are attainable in the high pressure position.



COMPRESSORS—Fast installation in minimum space without complicated engineering problems or excessive special machinery are features of compressors made by Davey Compressor Co., Kent, Ohio. Units are completely enclosed and have no exposed belt or couplings. Quietness and low vibration as well as lightness and compactness are other qualities noted by the firm. Only a small outlet is required for the 180-deg



Wells Overseas, Ltd., an associated company of Wells Cargo, Inc., Reno, Nevada, is using 16 KW-Dart 802-AT Tractors equipped with Fuller R-1160 ROADRANGER Transmissions in iron mining operations 250 miles south of Lima, Peru.

Geared with
FULLER ROADRANGERS

...91-TON LOADS

with double bottoms...

Featuring 9-speed Fuller R-1160 ROADRANGER Transmissions, 16 KW-Dart 802-AT Tractors handle up to 91 tons of iron ore at a time on a mining operation in Peru.

Owned by Wells Overseas, Ltd., the 320 hp KW-Darts use the single-stick, semi-automatic ROADRANGERS to provide maximum performance on the cross-country haul from crusher to the seaport of San Juan. Because the diesel engines can operate in the peak torque and hp range at all times, the 72-mile round trip is made in 3½ hours, including time for loading and unloading.

Ask about the Fuller Transmission designed to boost *your* profits.

STANDARD EQUIPMENT
on Fuller Off-Highway Transmissions

- **COUNTERSHAFT INERTIA BRAKE** . . . for quick, easy upshifts without double clutching . . . faster work cycles
- **PRESSURE LUBRICATION and FILTRATION SYSTEM** . . . for longer gear and bearing life . . . greater availability, less maintenance

FULLER

TRANSMISSION DIVISION
MANUFACTURING COMPANY
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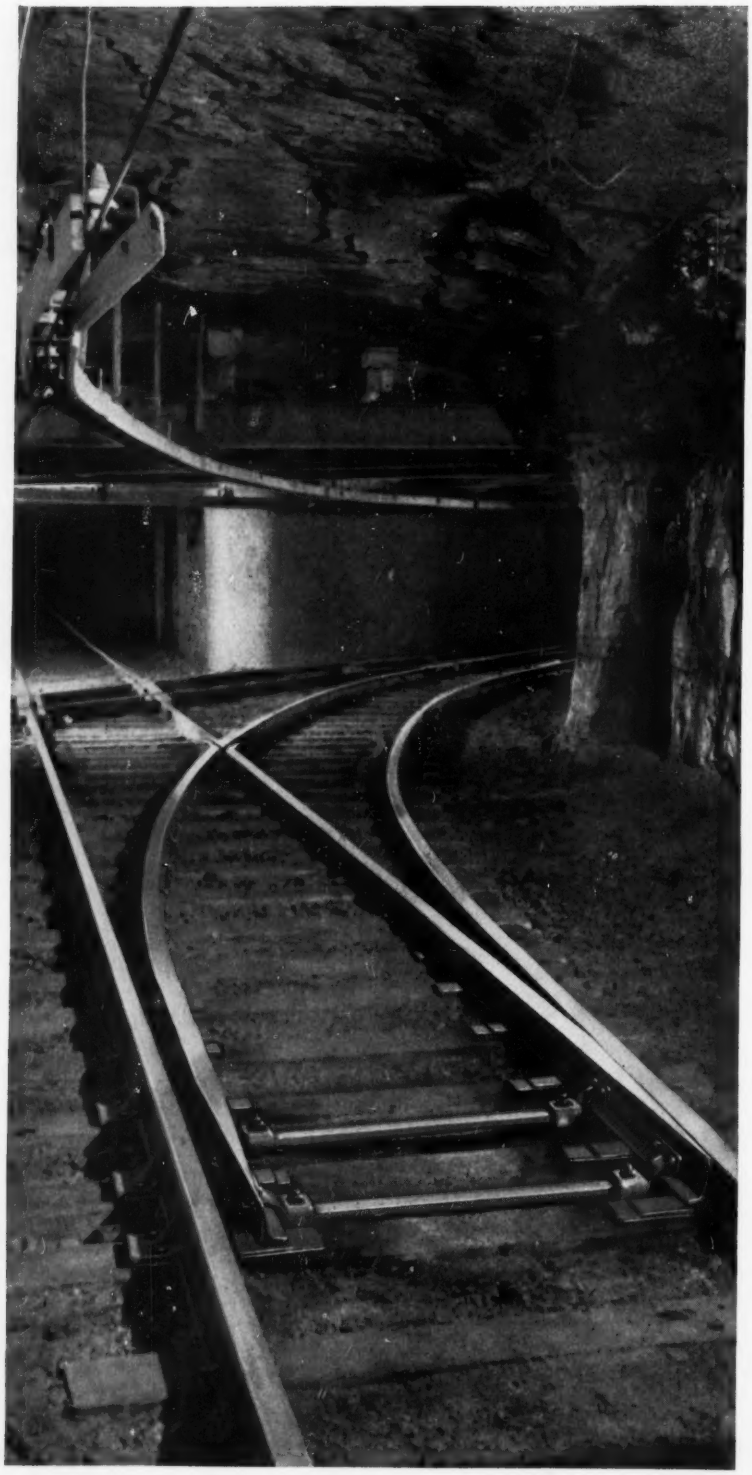

Have you a haulage system...

or just track?

If you feel your haulage system leaves something to be desired, we urge you to call in a Bethlehem engineer and let him study your plans. In this session he'll let you do most of the talking while he absorbs your problems, both present and anticipated.

Then he'll return to Bethlehem and go into a huddle with mine-track specialists here. Plans will be drawn up for your approval, after which all rail material will be prepared according to plan, including pre-cutting and curving to radius.

All important sections of track work will be completely assembled on our layout floors before shipment is made to you. When your order arrives at the job-site, all the waste and worry will have been ironed out of the project.

A Bethlehem prefabricated layout usually pays for itself in a hurry, through substantial operating economies. Like to talk it over? Just get in touch with our nearest sales office and we'll arrange a meeting.

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ESSO LUBES CUT COSTLY EQUIPMENT WEAR

1. NAKTA® Lubricants stay put in mine car wheel bearings even under the wettest conditions. Proved over many years and millions of miles of mine car wheel service.

2. NEBULA® EP multi-purpose grease is highly versatile . . . provides extreme-pressure and anti-wear qualities. Available in grades for both bearings and gears. Exceptionally resistant to water, oxidation, or thinning by heat. Reduces number of greases needed with their attendant costs of handling, storage and equipment investment.

3. AROX® EP Lubricants lower corrosion and wear in air powered equipment . . . 4 ways. (1) Guard against pounding wear with extreme-pressure agents; (2) Stick tightly to metal surfaces to ward off rust; (3) Minimize acid corrosion; (4) Atomize as desired in cold weather.

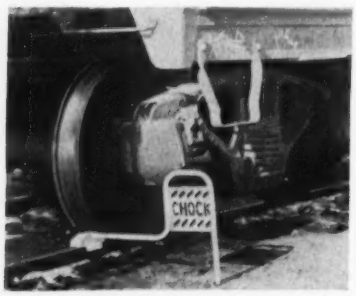
For further information on these and other special lubricants, contact your local Esso office or write: Esso Standard, Division of Humble Oil & Refining Company, 15 West 51st Street, New York 19, New York.

Esso

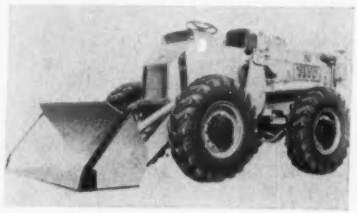
In Industry after Industry..."ESSO RESEARCH works wonders with oil"

Equipment News *(Continued)*

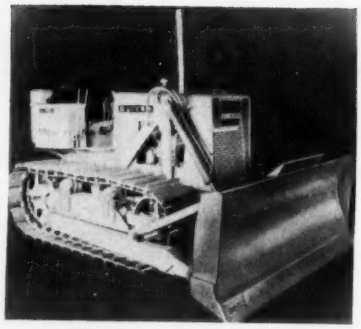
discharge air and users have the option of air-cooled or water-cooled units. A 40-hp unit, part of a line of 20- to 125-hp 100-psi compressors, is shown in the photo.



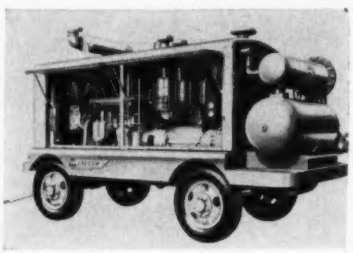
WHEEL CHOCKS—The Aldon Co., Chicago, Ill., has announced production of hardened-steel insert spurs to bite into rail heads as wheel pressure increases. This action increases safety by holding cars motionless under adverse conditions, declares the firm. The wheel chocks eliminate accident problems with both personnel and equipment in parking rolling stock, piggy-back loading and unloading, air-brake testing, riptrack repair and diesel hostling according to the firm. The Aldon "Safety Wheel Chock" is available in four styles, meeting every need on exposed or flush set rails, adds the company.



TRACTOR SHOVEL—Model 150, a 1⅝-cu yd tractor shovel, has been announced by N. P. Nelson Iron Works, Inc., Clifton, N. J. The machine, designed for heavy-duty work with maximum speed and efficiency, features underslung arms for greater operator visibility, 40-deg tipback bucket at ground level and maximum dumping height under the bucket edge of 9 ft. Forward reach at 7-ft dumping height is 5 ft 2 in. A Hercules G-298H 107-hp gas engine or D-298H diesel powers the tractor, which employs an Allison Torqmatic full-reversing transmission.



CRAWLER TRACTOR—The OC-9, a 62-gross-hp crawler tractor, now is in production at The Oliver Corp., Chicago 6. The new machine is the only crawler of its size to offer a new transmission providing independent power to each track, controlling both speed and direction, according to the firm. "Powerized" steering with Trans-O-Matic transmission introduces a new concept of operating ease, it is claimed. The operator can spot-turn on one track or execute a counter-rotation for the shortest turn possible. The bare tractor weighs 9,675 lb and maximum drawbar pull is 16,000 lb. A 4-cylinder valve-in-head diesel engine powers the tractor and use of a power-boosting torque converter drive between engine and transmission results in maximum use of horsepower.



NEW COMPRESSOR—Jaeger Co., Columbus, Ohio, has introduced a rotary air compressor that delivers 900 cfm of air at an operating speed of only 1,700 rpm. The machine is powered by the Model 6-110 G. M. diesel engine which, in other compressors, is operated at 1,800 rpm full-load speed, according to the firm. Reduction of 100 rpm in engine speed results in a fuel factor of more than 500 cfm of delivered air per pound of fuel consumed, says the firm. Engine and compressor wear are also reduced, adds Jaeger.

NEW BLADES — Specially-designed blades for use with the new International TD-25 diesel crawler tractor are now in production. The direct-lift hydraulic bulldozer blade and the direct-lift cable bulldozer blade, with cutting edges of heat-treated steel, have heavy-duty box-framed construction, says the firm. Tilt is easily adjustable to 18 in between

IT'S HERE---
A 10 KW T-LOAD

mercury contactor **for DC or AC work**

Compare this data

	6.6 KW-T	10 KW-T
Load Rating, Amp.	60	100
Coil Power, Watts	2.5	7.1
Contact Resistance (Ohms)	.0010	.0008
Coil Resistance (Ohms)	970	185
Pull in using 115V60 Coil	75V	80V
Drop out	61	75
Operate time (seconds)	.05	.06
Release time (seconds)	.07	.08

A new line of Mercury Contactors is now available in Durakool's famous Hypressure "Hydrogen Arc Quenched" construction. These heavy load carrying contactors have mercury to metal (tungsten) contacts.

Available in two sizes—

10 KW (10,000 watts) and 6.6 KW (6600 watts), normally open or normally closed contacts and any coil specification. Ideal for theatre and other lighting jobs—and for the switching of heavy motor loads. Made to handle up to 460 volts A.C. or 440 volts D.C.

Nude or with bakelite insulation—with or without lead wires.

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Durakool®
ELKHART, INDIANA

Farval solves tough lubrication problem

at coal cleaning plant

FARVAL—*Studies in Centralized Lubrication* No. 143

BEARINGS on a rotary car dumper are punished severely, require careful, thorough lubrication. Hit and miss hand-oiling is wasteful and seldom thorough or complete. To stop and grease the equipment by hand also ties up coal production. Some better method is needed to lubricate a rotary dumper adequately and surely, regularly and quickly, without stopping coal movement.

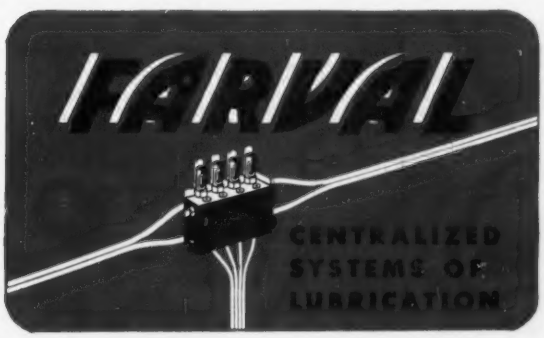
Management of one coal company found the answer in Farval Centralized Lubrication. Now with a few quick strokes and within seconds, a man lubricates every bearing on the car dumper from one convenient spot. It's that easy—and that fast!

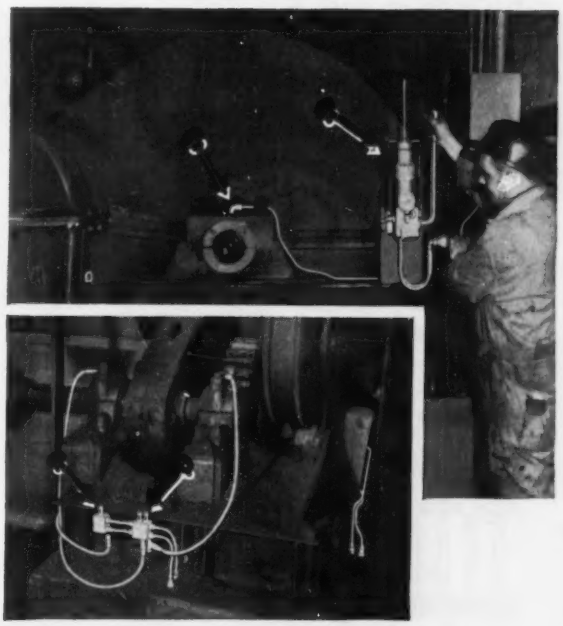
But the management of this mining company didn't stop here. They also put Farval systems on the other equipment in the preparation plant, including media densifiers, coarse screen shakers, separators, conveyors, crushers. Now machines are protected at all times, above or below ground, under all conditions. And production schedules are free of shutdowns for lubrication and from bearing failures caused by lack of oil.

Farval is the original Dualine system of centralized lubrication. The Farval valve has only two moving parts—is simple, sure and foolproof, without springs, ball-checks or pinhole ports to cause trouble. Through its wide valve ports and full hydraulic operation, Farval unfailingly delivers grease or oil to each bearing—as much as you want—as often as desired. Indicators at every bearing show that each valve has functioned.

Farval systems are designed for all kinds of mechanical equipment, big or small. Write today for free Bulletin 26. The Farval Corporation, 3288 East 80th Street, Cleveland 4, Ohio.

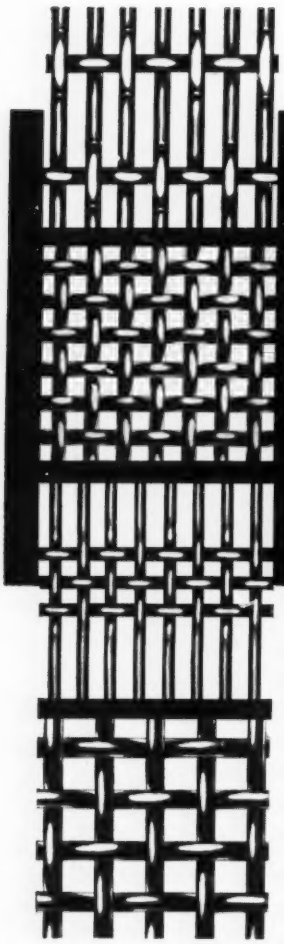
Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.





KEYS TO ADEQUATE LUBRICATION—Wherever you see the sign of Farval—the familiar valve manifolds, dual lubricant lines and central pumping station—you know a machine is being properly lubricated. Farval manually operated and automatic systems protect millions of industrial bearings. Photograph above shows workman lubricating Barney hoist which moves railroad cars into rotary dumper, and below, lubrication valves on trunnion under dumper.

Greatest Resistance To Wear, Breakage, Distortion



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SPACE SCREENS

IMMEDIATE DELIVERY
of most weaves and sizes

Ludlow-Saylor Screens and Wire Cloth can be furnished in any steel including SUPERLOY high carbon, LUDLOY oil-tempered, stainless or other alloys; Monel, bronze, copper, brass or any metal that can be drawn into wire.

Tougher wire with controlled ductility—tighter, rigid weaving—finish leveling to eliminate buckling and bulges—shearing, not burning, wire edges to make them absolutely square—precision applied hook strips for easier installation and higher tension...

These are the reasons L-S Screens last up to twice as long, give more efficient one-pass separation, increase output, improve product uniformity and quality.

Order, insist on L-S Screens. *Write for Condensed Screen Reference Catalog.*

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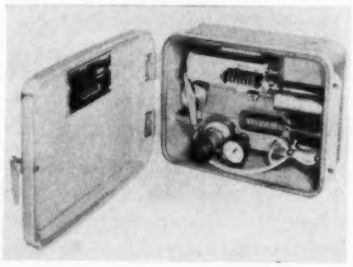
LOS ANGELES Star Wire Screen & Iron Works, Inc. (L-S Subsidiary), 2515 San Fernando Rd.
BIRMINGHAM 512 N. 18th St. CHICAGO 6261 West Grand Ave.
PITTSBURGH Union Trust Bldg. HOUSTON 5638 Harvey Wilson Dr.

FOUNDED 1856

Equipment News *(Continued)*

blade ends and there is a maximum pitch of 10 deg. Weight of the hydraulic bulldozer blade is 8,720 lb and that of the cable model, 7,950 lb. Blade length is 12 ft 3¾ in, height, 49 in.



INTEGRATOR—A simplified pneumatic integrator for accurately weighing material passing over conveyor belts of its continuous weighers has been announced by B-I-F Industries, Inc., Providence 1, R. I. The new machine automatically integrates (multiplies) belt travel with belt loading to produce direct readout of the true weight being conveyed over the weighing section of the firm's Conveyoflo, a flow meter for bulk dry materials.

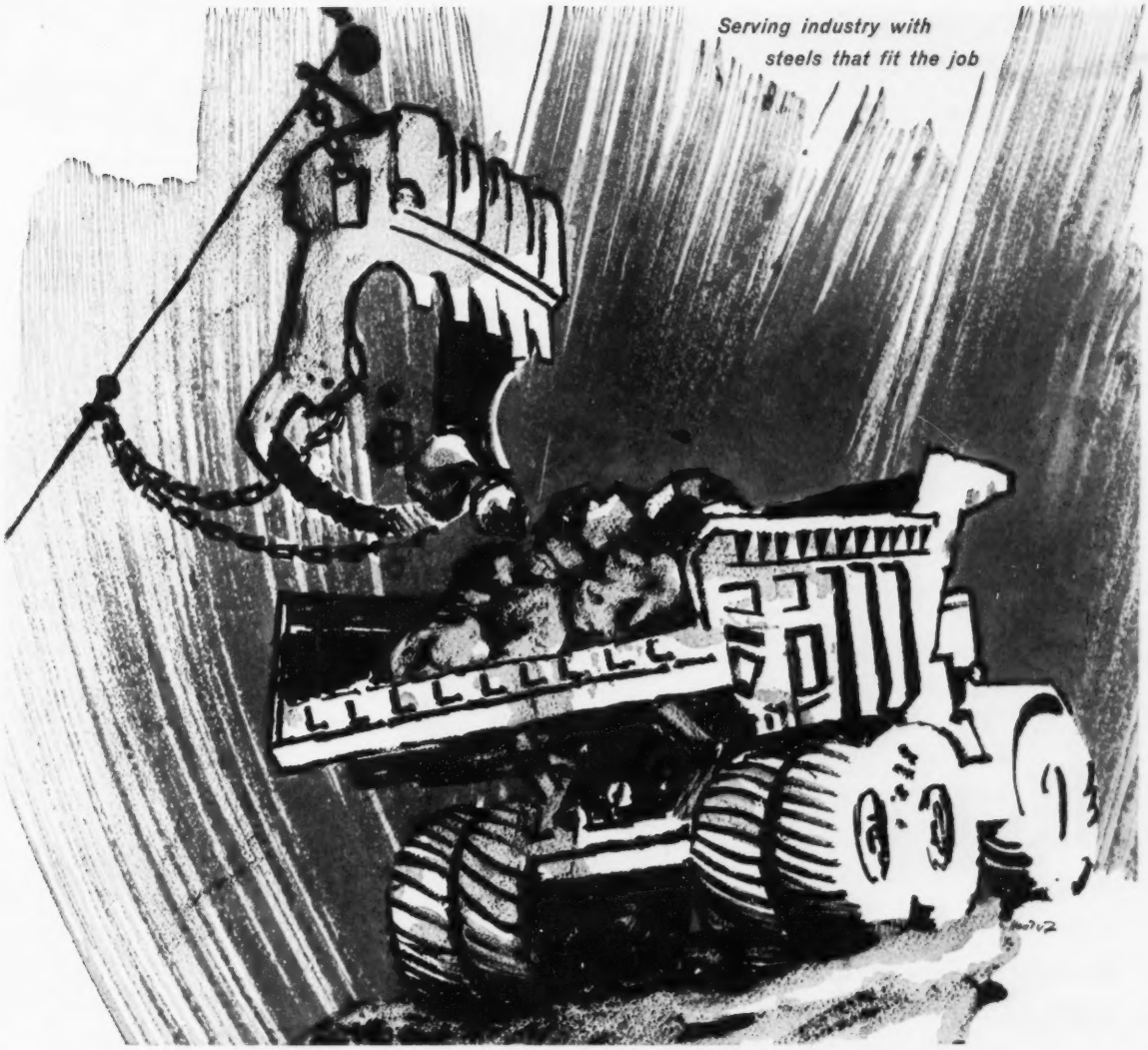
TRACK ADJUSTER—A hydraulic track adjuster, replacing a screw type, is a new product of International Harvester Co.'s Construction Equipment Div., for all future International TD-20 crawler tractors. Track tension is increased by using a regular hand grease gun to force grease into a lubricating fitting on the adjuster. To ease tension, a relief screw is backed off allowing grease to escape. A slotting arrangement of the screw eliminates any danger of pressure buildup from behind as the screw is being backed off, notes the company.

VENTILATION FLOW – Epic, Inc., New York 38, is offering its new line of Davis Ventilating flow instruments for measuring air velocity in mine airways. Several models are available covering ranges from as low as 30 fpm up to 6,000 fpm. The instrument is of extra-high accuracy, handy to use and light and precise, declares the firm.

ENGINE WELDERS—Small air-cooled engine welders, with engine idler and self-starter, introduced by The Lincoln Electric Co., Cleveland 17, Ohio, are said to have added convenience and improved economy. Features of the welder include engine speed control and self starting. The welder will accelerate to operating speed instantaneously when the arc is struck and slow to idling speed 8 to 10 sec after the arc is broken. Engine wear is reduced and fuel consumption is dropped up to 35%, reports the manufacturer.

(Continued on p 172)

Serving industry with steels that fit the job



GET TOUGH

WITH LUKENS "T-1" STEEL
TRADEMARK

Where the going gets rough, versatile Lukens "T-1" steel fights back. For repair or modification of heavy duty equipment such as truck beds, chutes, bucket teeth and dozer blades, this special duty steel plate can be ordered from *warehouse stock* in a wide range of plate sizes and gages. Lukens "T-1" is the modern mining steel—you can work and weld it in the field as readily as in your shop. Its terrific resistance to abrasive impact—coupled with an extremely high yield strength—means fewer replacements and often greater payloads. That's why more and more equipment builders are using Lukens "T-1" to provide longer life in shovel buckets, trucks and other mining equipment. Remember to specify the extra-tough 321 min. BHN quality. For performance and application details, request our special booklet, "Lukens 'T-1' for Toughness." Address Manager, Application Engineering Dept., M20 Services Bldg., Lukens Steel Company, Coatesville, Pennsylvania.

You can order Lukens "T-1" steel plate from these Steel Service Centers:

Alabama, BIRMINGHAM 2, O'Neal Steel, Inc., P.O. Box 2623 • **California,** LOS ANGELES 54, Earle M. Jorgensen Co., P.O. Box 2358, Terminal Annex, 10650 S. Alameda St. • LOS ANGELES 33, The R. J. M. Company, 238-248 South Mission Rd. • **Illinois,** CHICAGO 8, Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts. • **Kentucky,** ASHLAND, Mansbach Steel Co., 19th St. and River Front • **Maryland,** BALTIMORE 2, Wm. G. Wetherall, Inc. 317 President St. • **New Mexico,** ALBUQUERQUE, Miller and Smith Mfg. Co., Inc., 500 Phoenix Ave., N. W. • **Ohio,** CLEVELAND 6, Mills-Wolf Steel Co., 12434 Cedar Rd. • **Oregon,** PORTLAND 4, J. E. Haseltine & Co., 115 S. W. Second Ave. • **Pennsylvania,** McKEES ROCKS, Follansbee Steel Co., 200 Bradley St. • **Quebec,** MONTREAL, Drummond, McCall & Co., Ltd. 930 Wellington St. • **Utah,** SALT LAKE CITY, Structural Steel & Forge Co., P. O. Box 300 • **Washington,** SEATTLE 4, Stack Steel & Supply Co., 500 Landers St. • SPOKANE 10, Union Iron Works, East 217 Montgomery Ave., P. O. Box 2135.

LUKENS

American Coal Crushers are RUGGED!

Soundly engineered and constructed to give you many years of high volume crushing at low operating costs.

1. Oversize bearings.
2. Alloy Steel heat treated rotor shaft.
3. Heavy rib reinforced housing with renewable liners and tramp metal pocket.
4. Manganese Steel crushing elements.
5. Exclusive American-Originated rolling shedder ring which splits coal instead of crushing it.
6. More efficient crushing design which permits slower operating speeds and less power consumption per ton of coal crushed.
7. Dual adjustment to give flexibility of size control and to compensate for wear.
8. Maximum flexibility of rolling ring rotor prevents injury from tramp iron.
9. Full width screening area gives faster discharge of reduced product.

Coal Crushers exclusively, from Sample Crushers to Capacities of 800 TPH
Write for literature stating capacity you need.

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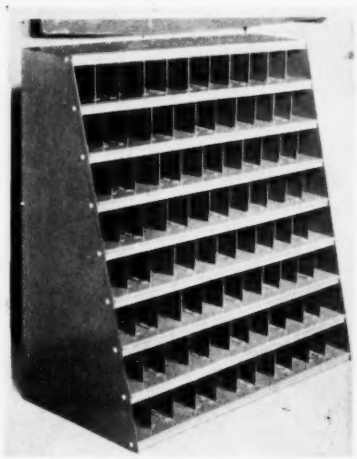
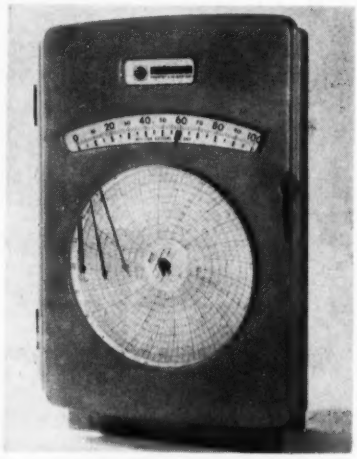
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS
1119 MACKLIND AVE. SAINT LOUIS 10, MISSOURI

Equipment News (*Continued*)

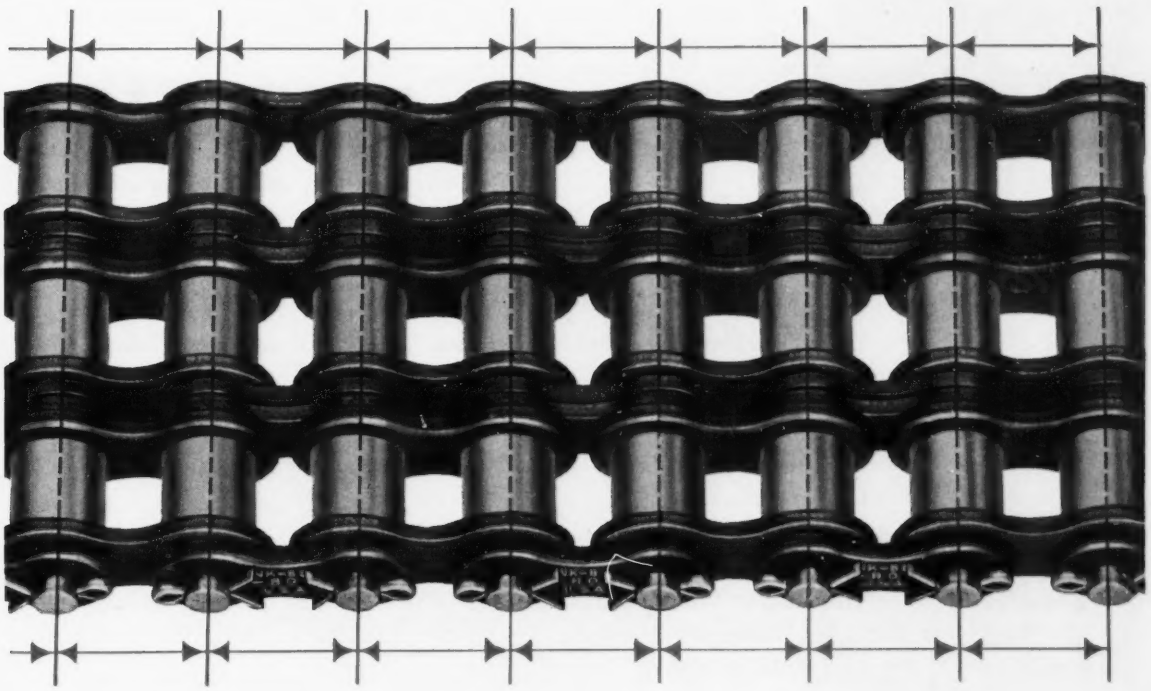


STORAGE UNIT – For storing related tools and parts which vary in size, a cabinet unit has been introduced by Bay Products, Philadelphia, Pa. Shelves vary in depth from 16½ to 7 in so that each equipment item can be kept at the front, easily visible and reached. Bin dividers are also adjustable horizontally on a 1-in center, and a full width label-holder is provided for each shelf. The cabinet measures 33⅝ in wide, 17 in deep and 34½ in high.



INSTRUMENTS—New sensitive Chronoflo® recorder-receiver arrangements have been announced by B-I-F Industries, Builders-Providence Div., Providence 1, R. I. For control of materials in motion, the instruments feature newly-engineered power positioners with faster quieter response, up to 16 control switches for alarm and control functions, swing-out panels for easy access, modular construction and multiple pen arrangements. Chronoflo is adaptable for telemetering flow, pressure, temperature, level, position or electrical quantities, according to the firm.

(*Continued on p 176*)



Equal length... equal strength

How pre-stressing ensures uniform load distribution of multiple-width LINK-BELT roller chain

Pre-stressing is one of the reasons why Link-Belt multiple-width precision steel roller chains easily handle the grueling loads common on today's drives. It seats and cold works the chain joint parts, assuring equal load distribution across the chain, minimum initial elongation, increased fatigue life.

Pre-stressing is just one of many "extras" that contribute to the *greater dynamic strength* of Link-Belt roller chain. Others include: close heat-treat control, lock-type bushings, shot-peened rollers, pitch-hole preparation. For details see Book 2657.

PRE-STRESSING MACHINE provides the pull that "sets" the parts of Link-Belt multiple-width roller chain. Besides assuring uniform load distribution, pre-stressing eliminates application difficulties on fixed center drives because the chain leaves the factory at precise operational length.

LINK-BELT

ROLLER CHAINS AND SPROCKETS

BOOK 2657 has 154 pages of roller chain data. Contact your nearest Link-Belt office or authorized stock-carrying distributor. (See CHAINS in the yellow pages of your phone book.)

15,077

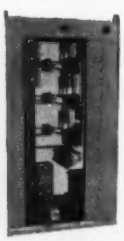
LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World.

THE BETTER WAY

The P&H way—"the better way" of design and construction puts P&H Electric Shovels in a class by themselves—they alone are not essentially the same as the shovels of a generation ago.

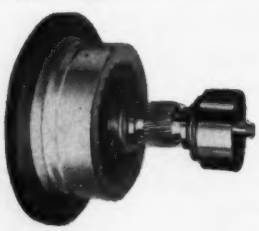
P&H has always been the pioneer developer of dramatic new designs and processes—this is why P&H Electric Shovels incorporate design fundamentals which make them different from all others. By their pioneering, P&H found "the better way" to production premiums as high as 10%, lower unit cost and more net profit for P&H owners.

Some exclusive P&H design fundamentals not found in other electric shovels are:



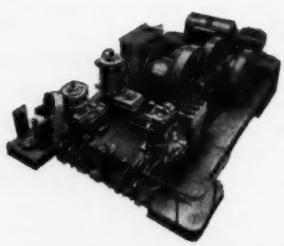
1. ELECTRONIC CONTROL

This patented P&H control accomplishes the quickest work motion reaction time known for electric shovels. Control maintenance expense is reduced as much as 80% by elimination of all moving parts for a completely closed circuit system.



2. MAGNETORQUE® HOIST DRIVE

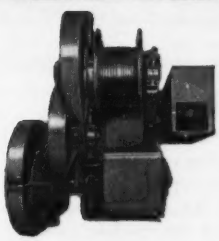
This patented hoist drive electro-magnetically transmits the full digging power of an A.C. motor direct to the dipper without motor generator set conversion to D.C. current! It gives up to 30% higher bail pull for more uniform digging speed and greater dipper fill factor.

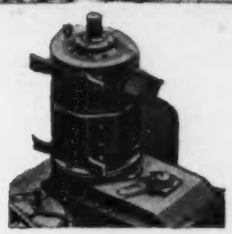


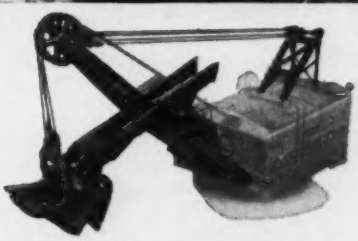
3. FULL WELDED STEEL CONSTRUCTION

P&H was the originator of electric shovel construction by the unit welded rolled steel method. Their accumulated wealth of experience pays P&H owner dividends in the form of exceptional long shovel life in hard digging—accomplished by full welded steel construction.

"P&H is now the world's largest builder of full-electric and diesel-electric shovels. Only P&H manufactures their own electrical as well as mechanical components—designed specifically for electric shovel service—gives you the service assurance of single source responsibility."







4. ENCLOSED HOIST MACHINERY

Only on the P&H Shovel is all deck machinery—the power trains for hoist, swing and propel drives—enclosed in oil tight gear cases. No open gearings! Modern power train design at its best!

5. INDEPENDENT CRAWLER PROPEL MOTOR

Only P&H Electric Shovels have an independently motored crawler propel drive. P&H gives shovel owners the advantages of independent motoring—the basic principle of electric shovel design and purpose. The P&H is FULL-ELECTRIC in every work motion.

6. T-1 STEEL ... SHOVEL ATTACHMENT

Only P&H furnishes as standard a boom and dipper handle fabricated of ultra high strength T-1 steel for high impact absorption ability, especially important in sub-zero temperatures. P&H pioneered and is the most extensive user of rolled alloy steels.

P&H MINING EXCAVATORS

HARNISCHFEGER CORPORATION • Construction & Mining Division • Milwaukee 46, Wisconsin

P&H LINE

Full-Electric and Diesel-Electric Shovels & Draglines: 3½ through 10 yds.

Diesel Excavators: ½ through 3½ yds.

Truck Cranes: 10 through 80 tons

look...

it has a tapered slot!

A NEW IDEA IN PREPARATION SCREENS

the Wedge-Wire

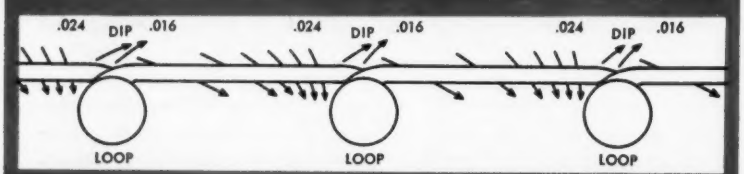
*TAPER-SLOT

patent applied for

designed to eliminate blinding when screening large amounts of near-opening size materials

* From loop to loop, the opening or slot gradually increases in width. This new design enables materials that would normally lodge between the wires to be transported, with flow of the mass, to the larger opening of the taper slot. At this point the material either passes through the screen or becomes loose. In addition, the "dip" created by Wedge-Wire loop construction, frees oversize materials and allows them to continue on with the material flow. These factors are responsible for the high efficiency of the TAPER-SLOT screen.

The new TAPER-SLOT can be easily interchanged with other types of Wedge-Wire Kleenslot screens. Available in all Wedge-Wire materials.



* for example: .016 opening tapered to .024 the combination of opening sizes would be the same between each loop throughout the entire screen.

WEDGE WIRE CORPORATION
Wellington, Ohio

write for additional information . . .

Equipment News (*Continued*)

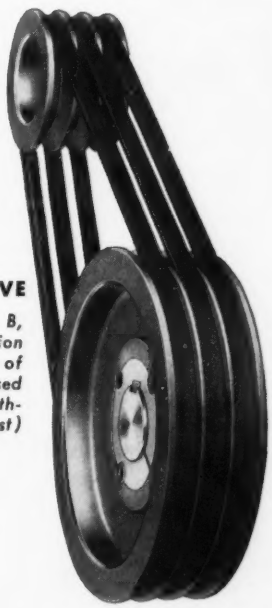
CLEANING—A new cleaning, derusting and descaling device has been introduced by the Swissair Tool Corp., Buffalo, N. Y. Similar to the Swiss-made Vonarx air gun, which the firm brought out in 1958, the new air gun, Model 1B, is smaller and more compact. Lightweight (3.3 lb), it has little recoil and can be used with one hand, states the company, leaving one free hand to perform minor tasks in the operating area. The tool's small size permits its use in small openings and inaccessible spots (overall length—13.5 in, diameter—1.25 in). The 1B operates on compressed air from any industrial-type compressor and is equipped with stainless-steel needles. A trigger on the handle releases a flow of air that sets the needles into rapid back-and-forth action. The air continues on through the pistol, blowing the working surface clean. Each needle operates independebly of the other thus allowing the needles to adjust to the contour of the surface being cleaned. Needles operate at 50 strokes per second. Total stroke length is 1 in. Air consumption is 12.5 cfm and air pressure is 80 to 100 psi.

CAR CONTROL—A semi-automatic control developed by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis., for man mine cars, permits safer and speedier transportation of miners to their job sites, according to the firm. The device consists of a control panel, a remote pistol-grip master switch and a dynamic brake pushbutton for slowdown action on slopes. A new safety feature is the control's forward-off-reverse master switch which is designed to return to the "off" position if the operator removes his hand from the grip. All controls are contained in permissive (explosion-proof) enclosures.

(*Continued on p 182*)

an entirely new line of V-Belt Drives.....

DODGE Dyna V



BIG-GROOVE TAPER-LOCK DRIVE

(— using standard A, B, C, D and E cross section belts, the hp ratings of which have been increased an average of 40% without any increase in cost)

DYNA-V TAPER-LOCK DRIVE

NEW HIGH CAPACITY

NEW COMPACTNESS

NEW SAVINGS IN COST

COMPARISON, ILLUSTRATED ABOVE — 3 HP, 1750 RPM, 2.41 TO 1 RATIO

	BELTS		SHEAVES			CENTER DISTANCE	HP	WEIGHT (LBS.)	COST	
	Number	Size	O.D. Driver	O.D. Driven	Width				Per hp	Per Drive
BIG-GROOVE TAPER-LOCK DRIVE	3	A42	4.15"	8.95"	2½"	12.3"	4.62	24.7	$5.62	$25.98
DYNA-V TAPER-LOCK DRIVE	2	3V400	3.35"	8.00"	1$\frac{3}{32}$"	10.8"	5.0	18.0	$4.50	$22.50
% SAVING *Savings vary with different sized drives*			19%	10%	56%	12%	+	27%	19.9%	13.4%

Dyna-V Drives are sensationally compact. They are capable of handling up to three times as much horsepower in a given space. Dyna-V opens vast new possibilities for better, more economical machine design. And, in most instances, *Dyna-V costs less!*

Narrower grooves, to match stronger, narrower Dyna-V Belts, greatly reduce the face width and the weight of Dyna-V Sheaves. Cost is lowered. Smaller diameter sheaves and shorter center distances multiply savings.

Dyna-V Sheaves decrease shaft overhang—increase bearing life. The new dimensional stability of Dyna-V Belts solves the problem of belt matching. Every belt carries its full share of the load.

Dyna-V Drives are available for capacities from 1 to 1500 hp. Ask your Dodge Distributor. Or write us for new Dyna-V Bulletin.

DODGE MANUFACTURING CORPORATION, 3000 Union St., Mishawaka, Indiana

DODGE of Mishawaka, Ind.

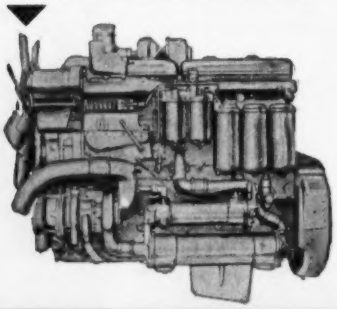
CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look under "Dodge Transmissioneer" in the *white* pages of your telephone directory, or in the yellow pages under "Power Transmission Machinery".

Power-steer and power-shift

with TD-25 standard equipment ...for full-load turns ...full-speed cycles!

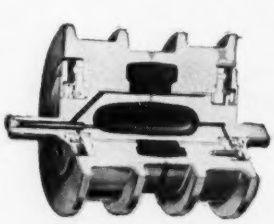
Keep big rock loads on the move *full time*, with exclusive Planet Power-steering. Full power on both tracks, full time is the answer! And Hi-Lo, on-the-go power-shifting lets you match power to condition, instantly, and keep the yard-boosting advantage of uninterrupted momentum!

Big power "plus" of the new TD-25 is the new direct-start, turbocharged 6-cylinder International DT-817 diesel engine. This versatile engine also powers International Payscraper®, Paywagon®, and rear-dump Payhauler® models — plus the TD-25. Equipment-spread power standardization simplifies your servicing and parts-stocking.



Cleaning the face of a Missouri strip mine behind a big dragline, this TD-25 shoves "tractor-sized" boulders aside with the greatest of ease. The "25" also builds dragline walkways and haul roads; pushes loaded trucks; and drastically cuts the cost of clearing new stripping areas.

Thickest-shelled roller design in the crawler industry—with king-size lube reservoirs and seal-protecting pressure-relief passages—let you power-lubricate without affecting seal life or efficiency. These are Dura-Rollers—the track rollers that make 1,000-hr lube intervals practical!



No attachment! No after-thought! No stop-gap!

Years'-proven Planet Power-steering and Hi-Lo power-shifting are *designed-in, built-in,* basic standard equipment of the new 230-hp International TD-25.

With "live-track" Planet Power steering, you get full-load king-size crawler efficiency on turns, as well as straight-aways. And Hi-Lo power-shifting gives you on-the-go matching of power to load to give you big, cycle-speeding advantages!

International Planet Power-steering eliminates load-limiting "dead-track" drag. And Hi-Lo power-shifting does away with time-wasting "gear-shift lag." No wonder the new TD-25 can outearn king-sized clutch-steered crawlers up to 50%—on tough high-walling; overburden removal; and many other coal, mineral, or building-material mining jobs!

Big-capacity track-and-engine teamwork

New TD-25 7-roller tracks are strength-matched to team with the full effort of the New 230 hp diesel engine. The "25" is platformed on super-rugged double-box-beam frames—and carried smoothly on International's new minimum-maintenance Dura-Rollers!

Press the direct-start button, to command the "25's" free-breathing diesel horsepower. Dual valving of the "25's" high-torque DT-817 engine provides for peak turbocharging efficiency—to deliver full-rated performance from sea level to timberline!

Full TD-25 performance is at your fingertips, full time!

Power-shift and power-steer the new "25" with king-sized loads—around curves, upgrade, anywhere. Compare years-proven simplified International planetary design that's engineered and located to break the load-limiting, time-losing steering and shifting bottlenecks which plague king-sized clutch-steered crawlers. Measure all the "25's" standard equipment extra value features. Let your International Construction Equipment Distributor demonstrate!

International® Construction Equipment

International Harvester Co., 180 N. Michigan Ave.

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers and Bottom-Dump Wagons . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carburetor Engines . . . Motor Trucks . . . Farm Tractors and Equipment.

Get DOUBLE EXPANSION for DEPENDABLE roof support with PATTIN roof bolts and expansion shells

STYLE D-1

The unique double expansion feature of all Pattin expansion shells insures *dependable* roof support, in hard or soft roof conditions. Their double holding power guards against failure — even under a 20 ton pull!

Pattin features include a parallel contact with the hole, and no definite drilling depth is required, as the shell can be securely anchored at any place in the hole. They anchor solidly and will not turn while being tightened. Wedge and shell are assembled in a manner to prevent loss of parts in handling, and the bolt and shell assembly are furnished as a complete unit. Plates are bundled separately. No special nuts or ears are required on the bolts. These features make a safer roof — and a safer roof means fewer accidents, increased production, more clearance for equipment operation and better ventilation.

Pattin specializes in roof bolting —it's our business, not just a sideline! Your business is important to us, and our service engineers are always available for consultation on your roof problems—ready to give you service when you need it! WRITE OR PHONE US TODAY for complete details.

Reg., U.S. and foreign Pat. Offices

The PATTIN split-type BOLT

The split-type bolt is one of the first slotted bolts, and continues to be a favorite wherever split-type bolts are used. Many mines still prefer this type. The bolt is a full 1-inch in diameter, with cut threads and furnished with hex or square nuts and various size plates and wedges.

IN WESTERN STATES

Pattin expansion shells are available and serviced exclusively by Colorado Fuel and Iron Corporation, Denver, Colorado. Western mining companies should contact them direct for information and consultation.

PATTIN

MANUFACTURING COMPANY
MARIETTA, OHIO

The PIONEER of roof bolting . . . established 1888

CF&I-WICKWIRE

DOUBLE GRAY®

HAS 15% GREATER BREAKING STRENGTH

. . . 15% greater than the catalog breaking strength of any improved plow steel rope with IWRC. That's because Double Gray is made with extra-improved plow steel that can better resist crushing and deforming on drums and sheaves of heavy mining equipment.

In addition to Double Gray, Wickwire makes all sizes and types of mining ropes, plus a complete line of slings and fittings. For complete details, ask for Wickwire's Mining Rope Folder. You'll find the nearest CF&I office listed in your phone directory. 7459

OFFICES LOCATED IN KEY CITIES EVERYWHERE

WICKWIRE ROPE

THE COLORADO FUEL AND IRON CORPORATION

Wickwire Spencer Steel Division: New York, N. Y.
Pacific Coast Division: Oakland, California
The Colorado Fuel and Iron Corporation: Denver, Colorado

WHAT YOU DON'T KNOW HURTS!

Most key mining officials read COAL AGE because it helps them do a better job.

If you're not a regular subscriber, Mail this coupon TODAY

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330 West 42nd St., New York 36, N. Y.

Send me COAL AGE for 1 year at $3 (U.S. and Canada only).

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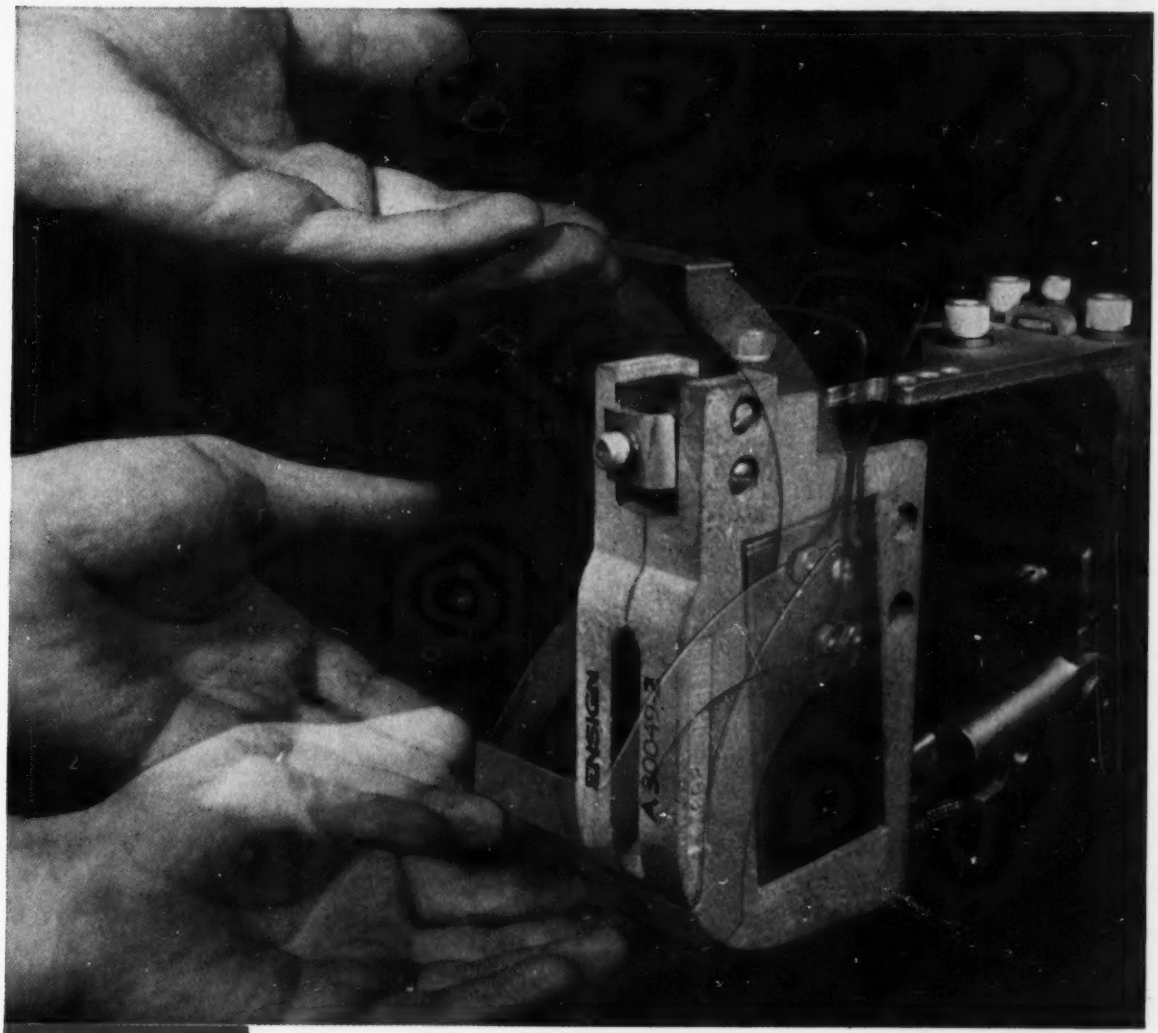
City ..... Zone ..... State .....

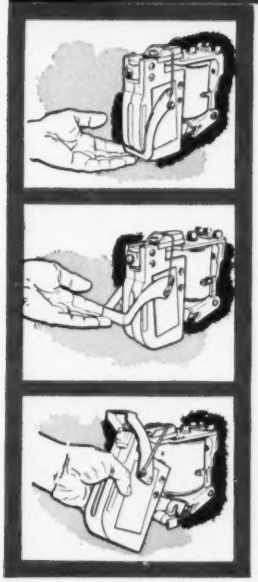
Mining Company .....

Hdqs. or Mine Name CA552

To Save Delay, Please Fill Out Completely

ENSIGN QUICK CHANGE CONTACTORS





"Save Down Time!"

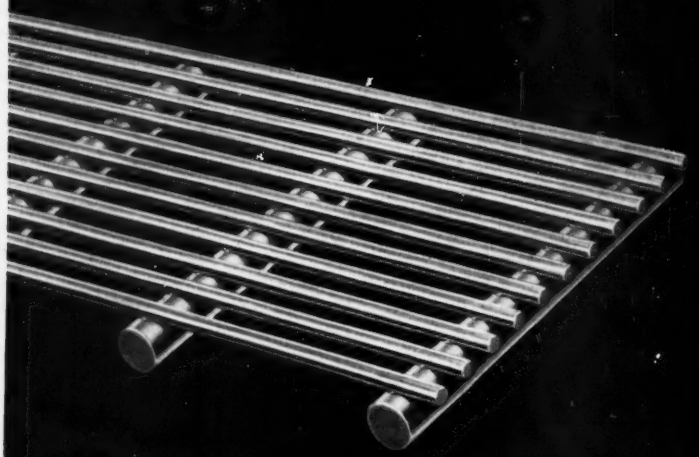
1. Remove and replace arc chute assembly in a fraction of the normal time *with one hand.*
2. No tools required.
3. All quick-change parts are captive.
4. Replace arc chute assembly in seconds, even on crowded and hard-to-get-to panels.
5. Makes possible easy inspection of contact tips.
6. Can be purchased as a complete contactor, arc chute assembly, or quick change kit only.

Bulletin Available On Request

ENSIGN
ELECTRIC AND MANUFACTURING CO.
914 Adams Avenue Huntington 4, W. Va.

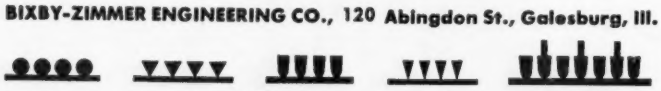
BEE ZEE ®

SCREENS THAT MAKE YOU MONEY



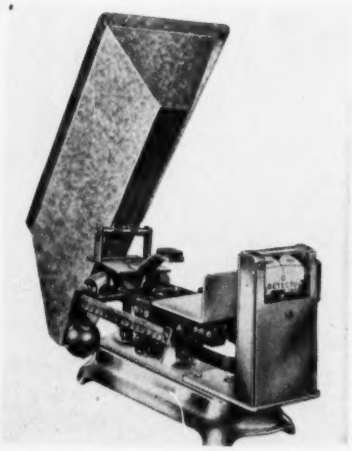
Your product has to be best . . . and so do your screens. Your present equipment can be equipped with Bee-Zee Screens, round-rod as shown above or in any of the special rod shapes shown below. Screens are all-stainless-steel and *all-welded*, with electronic control spacing the rods precisely. Find out how Bee-Zee Screens turn problems into profit — to make you money. Wire, write or phone Galesburg DIckens 2-5154 collect.

BIXBY-ZIMMER ENGINEERING CO., 120 Abingdon St., Galesburg, Ill.

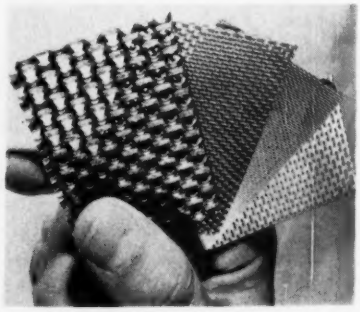


Bee-Zee Screens in a wide variety of shapes and sizes meet the needs of leading firms in the coal, minerals, quarry, oil, food, chemical, plastic, brewing, distilling, pulp and paper, rubber and other industries.

Equipment News (*Continued*)



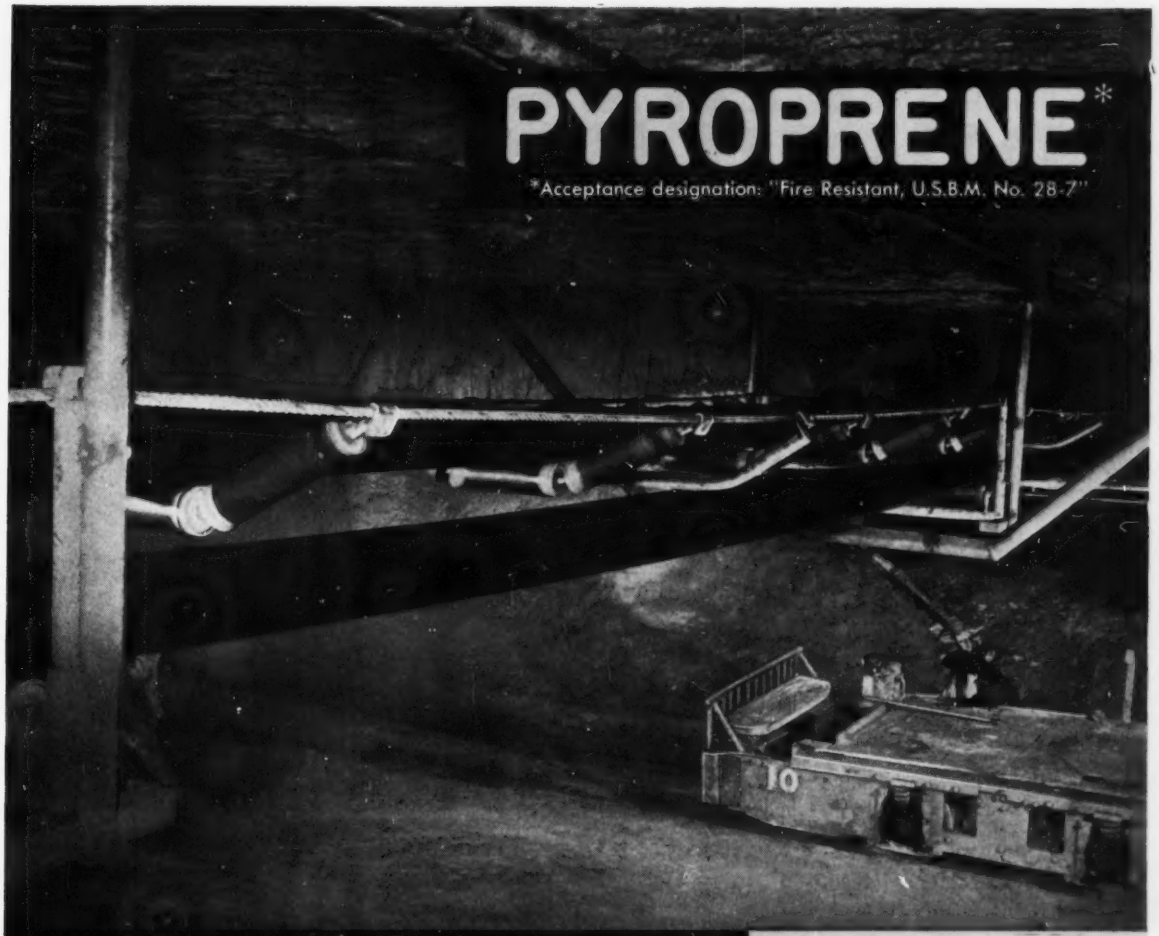
NEW SCALE – Detecto Scales, Inc., Brooklyn 5, N. Y., has a two-man packaging scale for straight or predetermined weighing that is said to simplify packaging operations. The scale's over-under dial head is fully enclosed and protected from moisture and dust. The curved lithographed dial chart is clearly visible from top or straight on. The extra-large pan of galvanized steel is hinged so that its contents are tipped right into bags or containers. One operator fills and views while the other empties and packs, and the slightest error is immediately indicated on the dial, declares the firm.



TOUGH SHEET—A new pierced metal sheet called "Conidure" has been introduced by Cross Perforated Metals, National-Standard Co., Carbondale, Pa. Made by a patented process, the metal sheet is said to last up to 3 times longer than perforated metal for screening, recovering or dewatering coal. Trapezoidal holes are pierced in sheets of carbon steel, stainless steel, copper, brass or aluminum. Sheet thickness can be up to 7 times hole diameter. Diameters range from 0.004 to 0.099 in, and sheet thicknesses range from 0.014 to 0.079 in. The working side of Conidure is available in several degrees of smoothness, from unrolled to rolled flat with electrolytic polish, depending on the type of operation.

PYROPRENE*

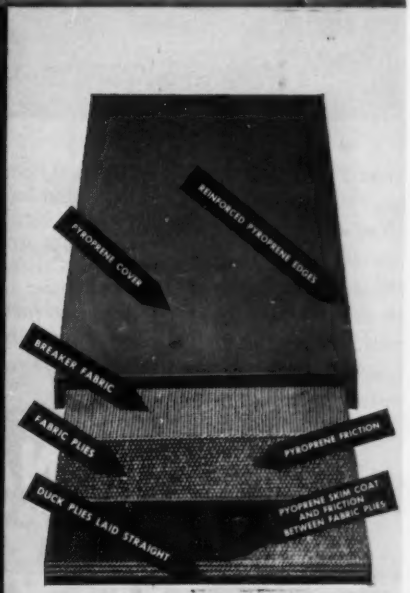
*Acceptance designation: "Fire Resistant, U.S.B.M. No. 28-7"



Here's one overhead that runs up big profits

This Acme-Hamilton 48-in. conveyor belt, on a Goodman Rope-belt Conveyor is carrying coal at 1500 tph with low maintenance costs and long service life. Note how nicely the belt troughs under the bulky load—and how flat it runs between the return idlers . . . sure signs of excellent construction and fine quality.

PYROPRENE PROTECTED against fire, Acme-Hamilton U.S.B.M. accepted belts will not feed or spread fire. The cover is fire-resistant Pyroprene; fabric plies and breaker fabric are encased with Pyroprene compound before the belt is built. Cover has exceptional resistance to abrasion and cutting. Write Acme-Hamilton Dept. CA-91.



Acme Hamilton

Serving Industry Since 1870

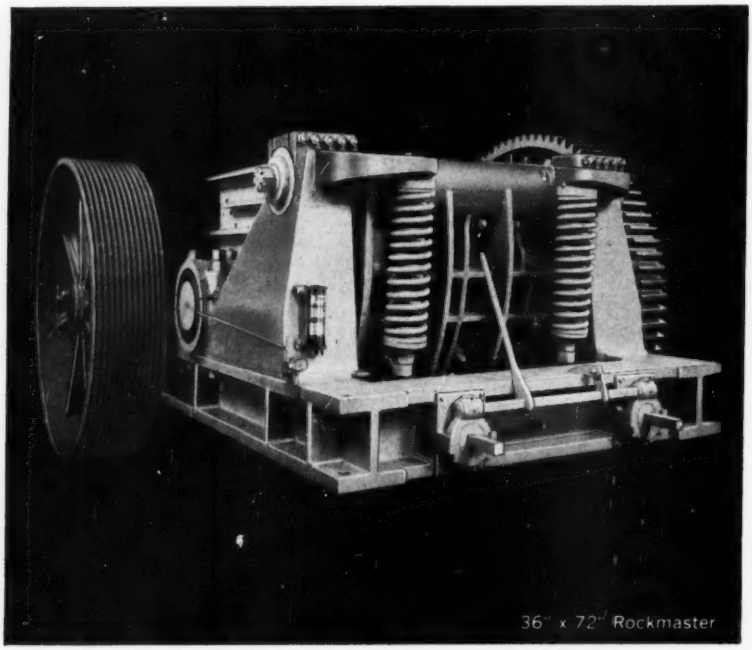
MANUFACTURING CORPORATION, TRENTON 3, N. J.

Divisions: Acme Rubber Mfg. Co. • Hamilton Rubber Mfg. Corp.

ATLANTA • CHICAGO • DETROIT • HOUSTON • INDIANAPOLIS • LOS ANGELES
MILWAUKEE • NEW YORK • PITTSBURGH • SALT LAKE CITY • SAN FRANCISCO • SEATTLE

world's FINEST CRUSHERS

for rock, slate and other mine refuse



High in capacity and ruggedly constructed, Rockmasters have the strength for economy and long service in the coal industry's most severe crushing applications. Steelstrut Toggle automatically releases tramp iron, while the Quick-Adjustment controls size ranges. Other advantages: Extraordinary ratios of reduction, lower power and maintenance costs, excellent resale value. *Get all the facts from Bulletin RMTD-56.*

McLANAHAN SINCE 1835

ROCKMASTERS

McLANAHAN & STONE CORPORATION

250 Wall Street • Hollidaysburg, Pennsylvania

Free Bulletins

EXCAVATOR—The American Hoist & Derrick Co., St. Paul 7, Minn., has released a 24-p catalog on the American Series 300 crawler crane-excavator. The catalog describes and illustrates features of the machine and its versatility on different-type jobs.

HAULING—A brochure published by LeTourneau-Westinghouse Co., 2301 Adams St., Peoria, Ill., provides information about the Haulpak off-highway truck line manufactured by the company. The catalog includes photographs and diagrams of the off-highway line, which has now incorporated 27-ton and 32-ton end dumps and 80-ton bottom dumps.

SURPLUS—Groban Supply Co., 1139 S. Wabash Ave., Chicago 5, has put out a 60-p catalog describing surplus industrial items, including hydraulic equipment, and machinery in the construction and diesel fields.

GENERATOR—An acetylene generator has been specially designed by Sight Feed Generator Co., West Alexandria, Ohio, to use 2x0 carbide, now available. The company has published a 4-p brochure which illustrates the features of this Model ATX generator.

LEVEL CONTROL — Stephens-Adamson Mfg. Co., 1460 E. River Road, Aurora, Ill., has announced Bulletin 159 on "Tellevel" bin level control switches. The new booklet features technical and engineering data, specifications and diagrams on the controls.

HOISTING—A new pamphlet from Vulcan Iron Works Co., 2960 S. Fox St., Englewood, Colo., discusses use of a low-cost hoisting system for small mines. Major savings in manpower are said to be achieved by the use of compact, economical skip-cages with integral push-button controls in an AC power system.

CIRCUIT BREAKERS—Molded circuit breakers are discussed in Bulletin 5001-1A published by I-T-E Circuit Breaker Co., 1900 Hamilton St., Philadelphia 30. The illustrated bulletin provides ratings, specifications and operating characteristics.

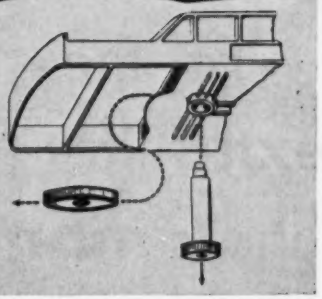
CONTROLS — Bulletin GEC-1260D, 72 pp, contains data on the complete line of control devices made by General Electric Co.'s General Purpose Control Dept., Schenectady, N. Y. Horsepower selection charts for motors from ¼ to 200 hp enable you to select starters, heaters and push-button stations.

(*Continued on p 188*)

MANITOWOC 4500

This Manitowoc 4500 handles 350 yards of material per hour near Columbia, S. C.

Millions of yards of overburden have been removed by Manitowoc 4500 6-yd. shovels and draglines — millions of yards, at the lowest maintenance cost per ton moved. The reason is simplicity — simple design that reduces the number of moving parts and channels power to the bucket smoothly. Let's look at some of the factors that contribute to this big mining machine's amazing low cost maintenance story. ■ Single-point adjustment for each brake and clutch band (or shoe) takes only minutes. It's easy to reach and turn the single nut and lock nut for the simple adjustment. ■ Gear lubrication is automatic with oil pumped from a main sump, filtered and carried to the gears. Centralized lube panels make quick work of greasing inaccessible spots. ■ Clutch and brake friction blocks are mounted on patented Vee-Block slides. There's no need to remove entire band to replace linings — another rough job made easier by Manitowoc forethought. All gears are spline-fitted for greater shaft strength and easy replacement. ■ You've just seen only a sampling of the reasons why the 6-yd. Manitowoc 4500 reduces maintenance costs and cuts downtime. Mail the coupon now for *all* the facts!



Special openings in the carbody allow all vertical shafts to be dropped for repair. Internal gears can be removed without disturbing horizontal shafts. Horizontal shafts above the rotating bed can be removed without disturbing any other. Here is just one example of Manitowoc design ingenuity that means less downtime and easier servicing.

MANITOWOC ENGINEERING CORP.

(A subsidiary of The Manitowoc Company, Inc.)

MANITOWOC, WISCONSIN

SHOVELS
1¼ — 6-YDS.

Manitowoc

DRAGLINES
1¼ — 6-YDS.

GET MORE INFORMATION TODAY!

MANITOWOC ENGINEERING CORP., Manitowoc, Wis. Dept. CA

Gentlemen: RUSH full details on the big output 4500!
I am specifically interested in: ☐ Shovel ☐ Dragline ☐ Both

Name.....

Company.....

Address.....

City..... Zone..... State.....

ROEBLING 2 AWG P-111 EM 1960
Sheath is tough, oil- and moisture-resistant, flame-retardant Roeprene.
Sheath surrounds and grips serrated conductor insulation . . . conductors are locked fast, can't "sleeve."
Ground conductor has braided green cotton covering. It strips clean for easy terminating, splicing.
GR-S insulation around each power conductor is heat- and moisture-resistant.
Ground conductor is braided and eased into shape from fine annealed copper wire for outstanding resistance to flexing fatigue and tensile stress.

For the **extra life** that's **money** in your pocket...

ROEBLING PARALLEL TWIN CABLE!

This economical, extra-flexible cable is available as Type G, with ground wire, or Type W, without. Complies with the flame resistance test of the State of Pennsylvania, Department of Mines, and the requirements of the U. S. Bureau of Mines, and carries the marking P-111BM.

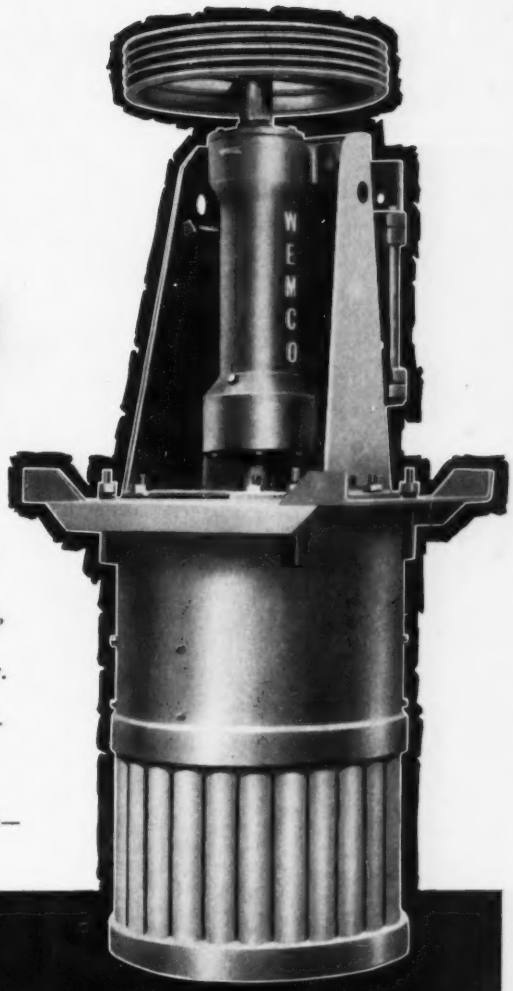
A combination of quality features makes Roeprene® Parallel Twin Mining Machine Cable different and better. Some of these features may seem like small details . . . but, taken together, they figure *big* in terms of easier installation and maintenance, and valuable *extra* service life. Flexible Roeprene Parallel Twin Cable is built to take tough treatment!

For more details about these cables, and the savings they mean, write Electrical Wire, John A. Roebling's Sons Division, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities
John A. Roebling's Sons Division,
The Colorado Fuel and Iron Corporation

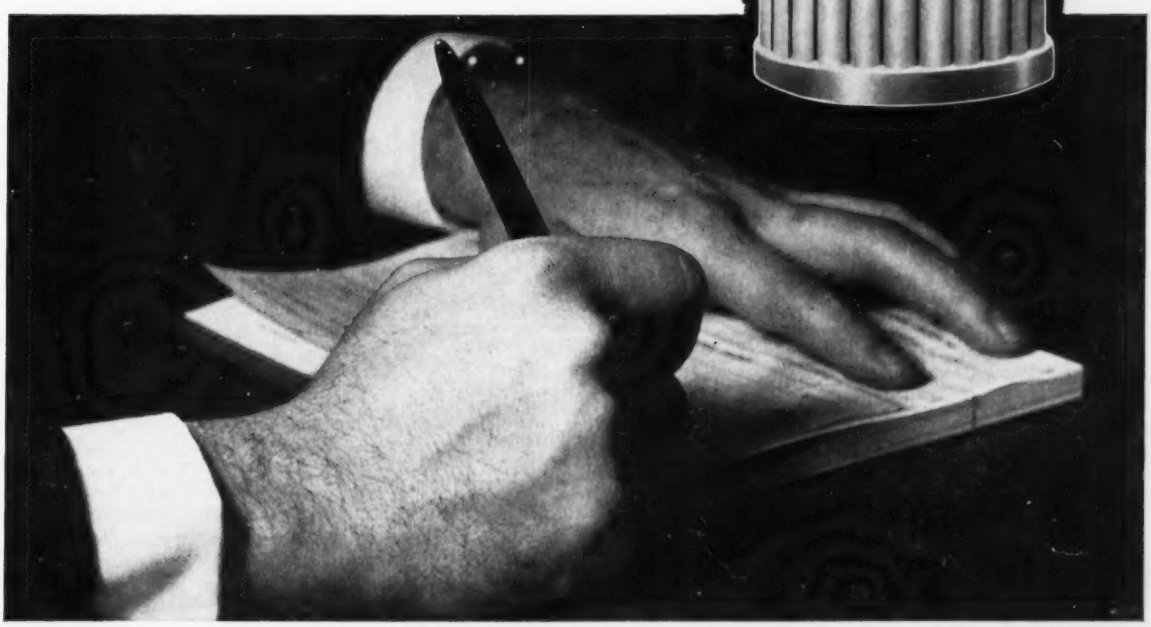
THIS DECISION WILL PAY BONUS PROFITS OF MORE THAN $6,500 EVERY DAY!



This order and installation of Wemco-Fagergren Flotation Machines by a leading coal producer will result in additional profits of over *$6500 per working day*—and for surprisingly low capital investment. Cost of the total plant addition, including the flotation cells, will be offset in less than four months.

This is another example of how Fags go to work—profitably. Recovery is consistently higher; floor space, maintenance and operating labor, reagent and other requirements are less.

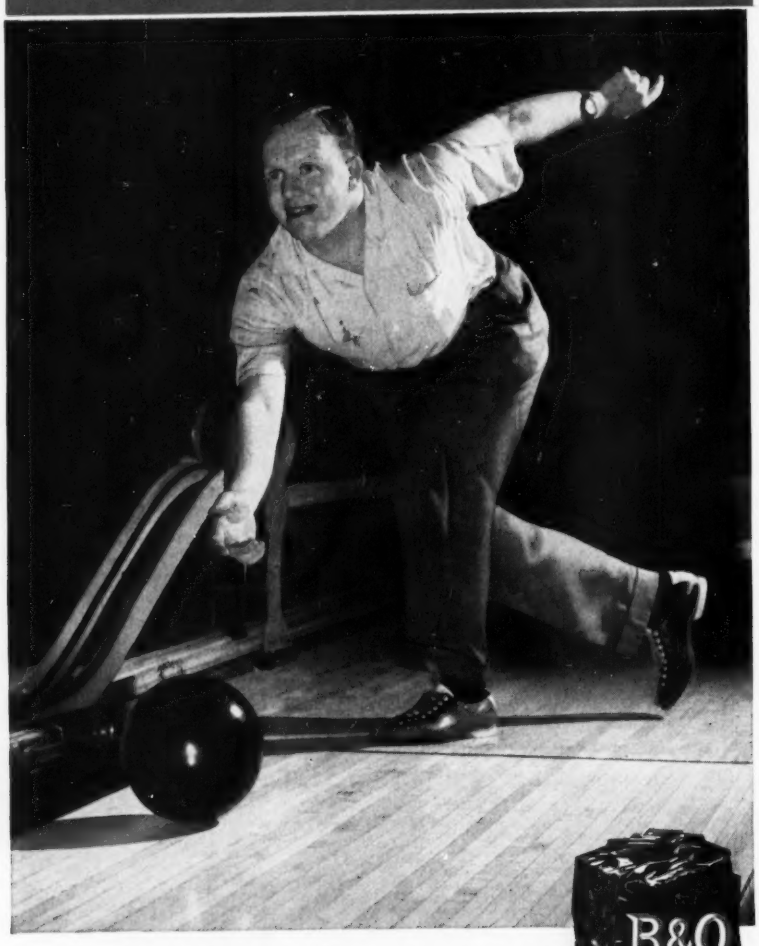
The Wemco-Fagergren record of profit-producing installations tells the story of sound experience. The men of Wemco will be glad to furnish all the facts and discuss why Wemco-Fagergren Flotation will do a better job—where flotation has a place.



WEMCO®

a division of
Western Machinery Company, 650 Fifth St., San Francisco, Calif.
and throughout the world

IT'S *what's behind*
THE BALL THAT COUNTS!

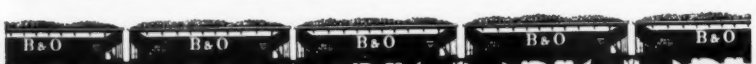


'...and Bituminous, too!

BEHIND BITUMINOUS is unlimited supply and ever increasing technology of utilization. *No other usable power source is backed by both these important characteristics.*

You can base your constant power-fuel needs on bituminous with confidence—B&O Bituminous, of course! ***Ask our man!***

BALTIMORE & OHIO RAILROAD, BALTIMORE 1, MD., PHONE: LEXINGTON 9-0400



BALTIMORE & OHIO RAILROAD
BITUMINOUS COALS FOR EVERY PURPOSE

Equipment News *(Continued)*

FINGER SAFETY – Protecting the worker's fingers is the subject of a new pamphlet from the National Safety Council, 425 N. Michigan Ave., Chicago 11. Entitled "A Simple Do-It-Yourself Project," the literature provides helpful hints for keeping fingers out of harm's way.

OUTDOOR LIGHTING—If you have an outdoor lighting problem, a new catalog issued by Stonco Electric Products Co., 333 Monroe Ave., Kenilworth, N. J., may be of interest. Catalog S condenses information about Stonco's cast-aluminum outdoor lighting products, and includes illustrations, specifications and dimensional drawings.

WIRE CLOTH—A 4-p bulletin from Newark Wire Cloth Co., 351 Verona Ave., Newark 4, N. J., describes and illustrates the firm's broad line of industrial wire cloth. Technical data regarding the selection, ordering and checking of such items as filter cloth, space cloth, mesh cloth and bolting cloth are included.

VIBRATION—Martin Engineering Co., Neponset, Ill., announces a 38-p catalog providing engineering data, specifications and a price list on the "Vibrolator" line of vibration inducers. Units are available in five motive powers—pneumatic, electric, gasoline, hydraulic and steam.

WELDING – Simplified procedures for making permanent electrical connections to any copper conductor or steel structure are described and pictured on a wall chart available from Burndy Corp., Norwalk, Conn. It shows how to use the ThermoWeld process for making a broad range of connections economically without an external power source.

BEARINGS—A new line of high-capacity spherical roller bearings is described in detail in a 52-p book available from Link-Belt Co., Chicago 1, Ill. The bearings combine three features described in the booklet: maximum diameter and quantity of convex rollers for each bearing size; precision-machined centrifugally-cast bronze retainers; and high, heavy inner-race shoulders.

FIRE FIGHTING—With an eye to safety, you may want to see a new catalog put out by Ansul Chemical Co., Marinette, Wis., describing its line of fire equipment. Some of the equipment items discussed include hand portable extinguishers, stationary fire equipment, piped systems and large-capacity mobile equipment such as fire jeeps and trucks. Among the new portable units featured are Ansul's "Monitor" extinguisher and the Sentry "Energized" series.

How to beat off corrosion attack!

Corrosion attack is a 24-hour battle in every mine. But, you can take the fight out of those trouble-making chemicals by installing USS National Polyethylene Pipe. It's the best pipe for mine drainage problems, because National Polyethylene Pipe is *tough;* it is unharmed by deadly corrosive mine water, acids, alkalies, salts, and other mine chemicals.

USS National Polyethylene Pipe is light, flexible and easy to handle. And it can take plenty of rough handling. Polyethylene Pipe performs efficiently in a temperature range of −90°F. to +120°F., and it won't crack or break in sub-zero weather.

And remember this: National Polyethylene Pipe eliminates the need for replacement pipe —*it's made to last.* You save money, because Polyethylene Pipe is the most economical pipe that can be used for mine drainage.

USS National Polyethylene Pipe is available in sizes from ½ inch to 6 inches in diameter, and in a variety of wall thicknesses. For complete information, write to National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS and National are registered trademarks

USS National Polyethylene Pipe

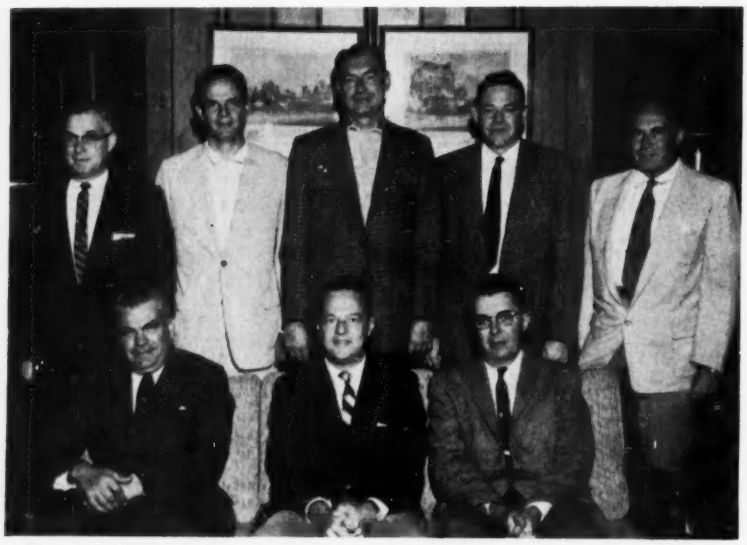
"The world's largest and most experienced manufacturer of tubular products"

USS National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

This seal of the National Sanitation Foundation means Tested . . . Approved . . . Sanitary!

Among the Manufacturers



NEW OFFICERS and directors were chosen at the 26th annual meeting of the Conveyor Equipment Manufacturers Association, held recently at Point Clear, Ala. Seen in the front row are (left to right): Orlan A. Johnson, president, Gifford-Wood Co.—new president; J. B. Nordholt Jr., president, Webster Mfg., Inc.—retiring president; E. H. Woodberry. manager, Industrial Products Div., Lamson Corp.—vice president; Back row (left to right): E. L. Weinthaler, vice president; Conveyor Systems, Inc.—director; G. H. Woodland, vice president, marketing, Chain Belt Co.—secretary; E. P. Berg, general manager, Pershing Road Plant, Link-Belt Co.—past president and director; H. A. Barber, president, Barber-Greene Co.—treasurer; and R. C. Sollenberger, executive vice president and head of the association's staff.

Continental Conveyor & Equipment Co., a new corporation composed principally of personnel of the parent organization, has completed purchase of the Industrial Div. of the Continental Gin Co., Birmingham, Ala.

Continental is a large manufacturer of conveying and materials-handling equipment. The brand name, "Continental Conveyor," will be retained and complete conveyor service will continue to be offered along with replacement and repair service on existing installations. Heading up the new corporation are: **Nelson J. Kemp**, chairman; **George R. Maples Jr.**, president; and **Raymond C. Kirkpatrick**, vice president and treasurer.

Plans for a $4 million expansion of earthmover tire production facilities at Goodyear Tire & Rubber Co.'s Topeka, Kan., plant have been announced.

Goodyear's new facilities will accommodate the maximum tire sizes presently anticipated to meet the need for larger construction machinery with higher horsepower ratings.

Wild Heerbrugg Instruments, Inc., has appointed Surveyors Service Co. of Los Angeles, Cal., western distributor for all Wild surveying instruments.

Duff-Norton Co. will expand and transfer operations of two divisions to a new plant in Charlotte, N. C.

The two divisions involved are the Jack Div., which has been located in North Side, Pittsburgh, and the Coffing Hoist Div., which has operated at Danville, Ill.

Kenneth W. Stalker has been appointed manager of engineering at Goodman Mfg. Co.

Mr. Stalker has been an engineer with General Electric for the past 9 yr and was most recently located at Evendale, Ohio. He is a graduate engineer as well as a holder of a law degree.

Peter Ambrosiani will manage the western territory for the Mining Div. of Jeffrey Mfg. Co., and will make his office in Denver, Colo.

Mr. Ambrosiani has a great deal of experience in the West Virginia, Kentucky and Pennsylvania coal fields.

Louis W. Jander, formerly assistant general sales manager, has been promoted to general sales manager of Yale Materials Handling Div., Yale & Towne Mfg. Co.

He will be in charge of domestic and Canadian sales of Yale's complete lines of industrial lift trucks, tractor shovels and hoisting equipment.

Charles R. Spencer has been appointed field sales manager of Gates Rubber Co.

Mr. Spencer, who has been manager

Typical Installation on Main Haulage

- Rugged.
- Low in Cost.
- Easy to Install
- Increases Production.

"Cheatham Switch"

TRACK SWITCH THROWER ELECTRICALLY OPERATED

This modern track switch is thrown swiftly and safely by motormen as they sit in their cabs. It saves time and money, and is fool-proof and dependable!

Over 50 years experience manufacturing

ELECTRIC TRACK SWITCHES and DERAILS

Write for Catalog

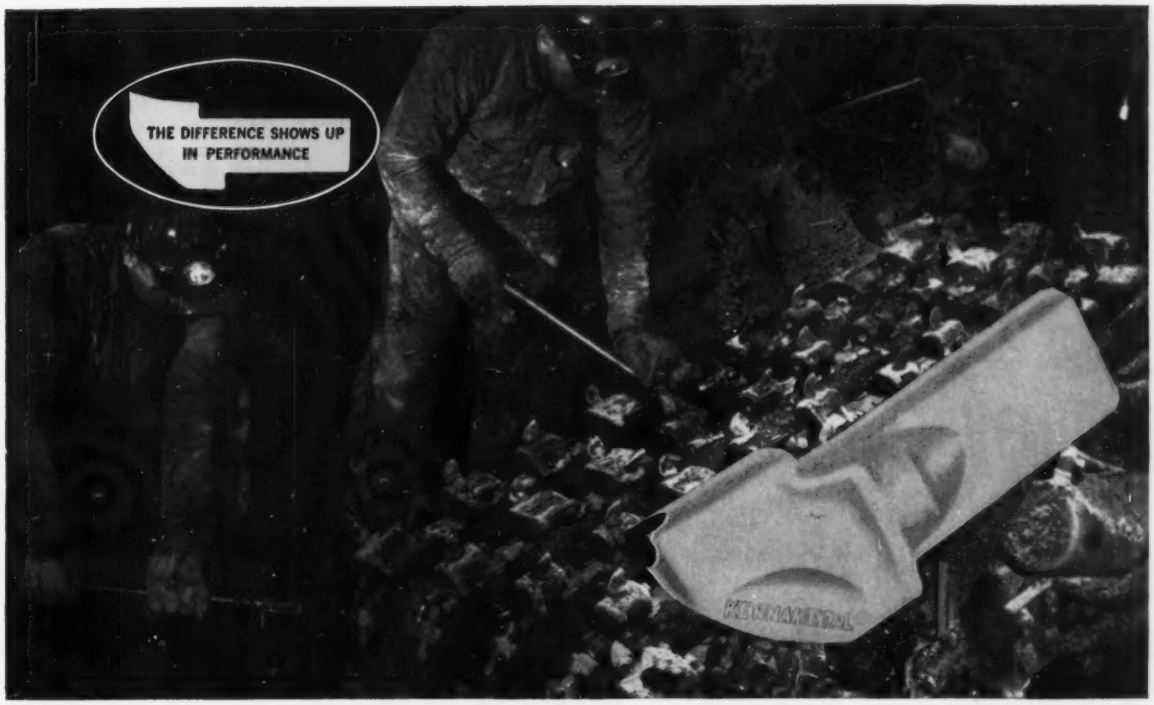
CHEATHAM ELECTRIC SWITCHING DEVICE CO.
INCORPORATED
4780 Crittenden Drive, Louisville, Ky.

NUSSCO AUTOMATIC BLOCK SIGNALS FOR MINES

Save Trip Time on Main Haulage
Prevent Collisions

A two wire cable connects two or more signals together into one block. Only one signal can show proceed on the entrance of a trip, all other signals show stop.

NACHOD & UNITED STATES SIGNAL CO
INCORPORATED
4771 Louisville Ave., Louisville, Ky.



Rugged Kennametal U3RA Cutter Bits installed in new type chains on a 1 JCM continuous miner. Close-up shows the strong shank design.

How do YOU compare bits?
On the basis of . . . Bit life · Tonnage · Bit cost per ton?

KENNAMETAL BITS EXCEL ON ALL THREE COUNTS

At this West Virginia mine, bit costs averaged 5½ cents a ton, using standard carbide bits. Irregular occurrence of sulphur lenses and balls in the Pittsburgh No. 8 Seam sometimes jumped the average to 9 cents, with some sections running up to 67 cents. Tip failures occurred more often than in normal cutting, but breakage of the ½" x 1" shank was the big problem.

Switching to lower cost steel bits with hardfaced tips lowered bit costs considerably. But it also lowered production.

Kennametal U3RA Bits not only reduced shank breakage, but tip failures as well. The average bit cost dropped from 9 to 7 cents a ton . . . and production in heavy sulphur sections more than doubled.

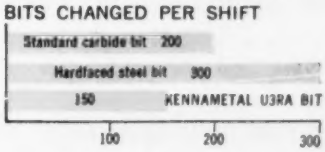
You can't pick good bits by appearance or price tags. Let the Kennametal difference show up in performance at *your* mine. Your Kennametal Representative will help you select and actually test Kennametal Bits in your mine. Call him, or contact us direct. KENNAMETAL INC., Mining Tool Division, Bedford, Pa. 97287

- Consistently high quality keeps Kennametal bits in service longer . . . resulting in fewer bit changes and more operating time at the face.
- Free-cutting design of Kennametal bits draws less power, permits faster cutting, maximum production, less maintenance.
- Every Kennametal bit is backed by 21 years of leadership in tungsten carbide tooling, including the development of the first carbide cutter bits for the American mining industry.
- Nineteen full-time Kennametal Representatives and the Kennametal Distributors—leading mine supply companies, provide assistance in solving your cutting and drilling problems and supply the tools you need . . . when you need them.

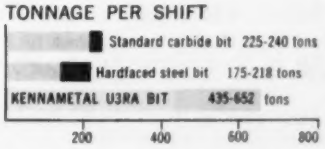
THE DIFFERENCE SHOWS UP IN PERFORMANCE

Different bits—same section—heavy sulphur

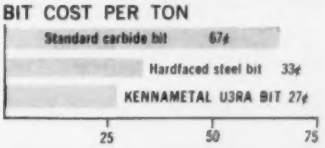
BITS CHANGED PER SHIFT



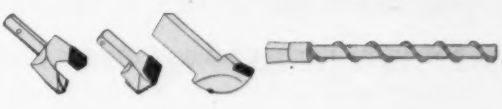
TONNAGE PER SHIFT



BIT COST PER TON



INDUSTRY AND KENNAMETAL
...Partners in Progress



VIP*

*If a man is making decisions . . . if you are paying him to think for your company . . . he is a Very Important Person.

A man's ability to grow, his job satisfaction, his performance for you . . . yes, your company's future earnings . . . are all intimately related to the amount of practical, profitable information he is continuously absorbing, and putting to use in his daily job. Today, demands are such that a successful man must be better informed than ever before . . . and successful men make successful companies. This is why the McGraw-Hill V I P Program of "engineered" business reading will give you so much personal satisfaction in your plans to move your company forward. If you are concerned with manpower development, you will want to read this new booklet, learn from other leaders now using this program. Write for your personal copy. . . .

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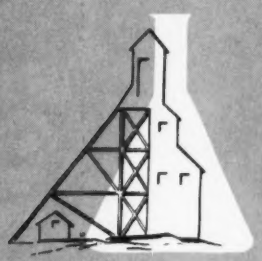
REAGENT NEWS

"ore-dressing ideas you can use"



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Flocculating Agents
Film Forming Agents
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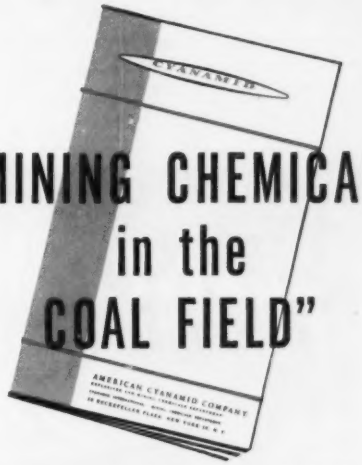
High Explosives
Permissibles
Seismograph Explosives
Blasting Agents
Blasting Caps
Electric Blasting Caps
Blasting Accessories

This new booklet gives you the facts you need on



"MINING CHEMICALS in the COAL FIELD"

This booklet discusses methods of solving stream pollution problems and the simultaneous possibilities of profitable recovery of fines now lost in breaker effluent.

Just published, it outlines methods of coal recovery by flocculation and froth flotation and also gives practical information on the chemicals required.

Here are some of the Cyanamid chemicals and suggested uses included for your consideration.

- **To remove solids from effluents with clearer thickener overflow . . . AEROFLOC® 550, 3000, 3171 Reagents and SUPERFLOC 16® Flocculant**
- **To float fine coal particles away from refuse . . . AEROFROTH® 65, 73, 77**
- **To improve wetting power of sprays to allay dust . . . AEROSOL® OT-75% Surface Active Agent**
- **To reduce or eliminate frothing and foaming of coal slurries . . . AERO® Depressants 610, 615, 620, 633**
- **To cut wind loss of exposed fines during storage or shipment . . . AEROSPRAY® 52 Binder**

For your copy of this helpful booklet, use the handy coupon below.

Please send me "MINING CHEMICALS in the COAL FIELD"

NAME_____

COMPANY_____

ADDRESS_____

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AMERICAN CYANAMID COMPANY
EXPLOSIVES AND MINING CHEMICALS DEPARTMENT

CYANAMID INTERNATIONAL — *Mining Chemicals Department*
Cable Address: — Cyanamid, New York

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Manufacturers *(Continued)*

of distributor sales since 1957, will now be in charge of over 200 field representatives in 20 districts around the United States.

Ellis B. Gardner has been selected as executive vice president of Hewitt-Robins Inc.

Mr. Gardner joined the company in 1946. He became controller in 1950 and vice president and treasurer in 1950. Since 1955 he has headed the firm's foam products division.

Dorace Dodd was named to the post of assistant manager, Tractor Div., Southern Dist., for Eimco Corp.

Mr. Dodd came to Eimco in 1947 as a sales engineer. He is a graduate of the University of Alabama and will continue to make his headquarters in Birmingham, Ala.

Lee Neff, formerly of the Neff & Fry Co., has joined the Industrial Silo sales representative staff of the Marietta Concrete Div., American-Marietta Co.

In his new position he will be in charge of Midwest sales, representing the firm in southwestern Ohio, southern Indiana, southern Illinois, Kentucky and Tennessee.

William G. Barnes has been named sales manager for blast hole drills, at Bucyrus-Erie Co.

Mr. Barnes, with Bucyrus since 1956, had been sales engineer for blast hole drills since the fall of 1958.

T. I. B. Gray has been transferred from the General Sales Dept. of Bemis Bro. Bag Co. to the firm's Packaging Service Dept.

Mr. Gray, who has been on special assignment in development and promotion of the new Bemis explosives bag, will join the sales section of the Packaging Dept.

Anaconda Wire & Cable Co. has announced several changes in the company.

David E. Allen, vice president-sales, has been elected executive vice president. **John L. Tindale,** formerly commercial vice president, has been advanced to the newly-created position of vice president-marketing and sales. And **Henry V. Van Valkenburg,** until now general sales manager, has been promoted to vice president and general sales manager.

C. P. Rooney, who has been treasurer of Mine Safety Appliances Co. since 1953, has been elected a vice president of the firm.

Associated with the company since 1927, Mr. Rooney is a graduate of Duquesne University with a B. S. degree in economics.

Victor Emery has been promoted to general sales manager of the Industrial Div. of Aeroquip Corp.

Mr. Emery was formerly manager of manufacturers' sales for the Industrial Div., and in his new post will continue to maintain headquarters at Aeroquip's Jackson, Mich., plant.

FASTEST WAY to keep coal MOVING from face to tipple

You can avoid costly loading-point bottle-necks by using STAMLER Car Spotters.

STAMLERS will move your coal FASTER . . . MORE EFFICIENTLY . . . and AT LESS COST than ANY OTHER METHOD! *This is proven by the production records of STAMLER users.*

In YOUR mine STAMLERS will pay for themselves in a surprisingly short time. Maintenance cost is so low as to be practically negligible. *The first STAMLER ever built is still in active use.*

STAMLER has 50% MORE car spotters in use than any other make! There must be a reason. Ask for details.

STAMLER Hydraulic CAR SPOTTERS

SCHROEDER BROTHERS, Exclusive Eastern Sales Agent Pittsburgh, Pennsylvania

UNION INDUSTRIAL CORP., Carlsbad, New Mexico

W. R. STAMLER CORPORATION

PARIS, KENTUCKY

SALMON & CO., Birmingham, Alabama

WESTERN SALES ENGINEERING CO., Salt Lake City, Utah

Bethlehem contact men move fast, talk sense, work right alongside you

Here, one of our teams tests the anchorage capacity of a Bethlehem Roof Bolt assembly. If you're interested in learning more about roof bolts, remember that our men are ready to do a lot more than just talk. They'll help you with the original installation and testing of mine roof bolts and accessories. Just let us know where and when.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

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40 Years' Service to the
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EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

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Send New ADS or Inquiries to Class. Adv. of Coal Age, P. O. Box 12, New York 36, N. Y., For March Issue Closing February 17th

ANNOUNCEMENT

The Allegheny River Mining Company of Kittanning, Pa. has requested that I offer for sale the equipment retired when they discontinued their continuous highwall mining operation. The machinery consists of a Jeffrey Colmol Continuous Miner, Joy crawler mounted Extensible 30 inch Belt Conveyor, Diesel driven A. C. Generator, all together with supplies and equipment necessary in the conduct of a continuous mining project. All the above is quality equipment that produced extra-ordinary high tonnage in low coal with very small labor cost.

To anyone interested in the purchase of all or any part of this equipment we will be pleased to furnish detailed description and arrange for inspection.

K. O. Shaner
Box 455 Kittanning, Pa.
Phone LIberty 5-3521

EXPLOSIVES SALES

Excellent opportunity for young graduate engineer with explosives or mining experience to join the Industrial Chemicals Division of Spencer Chemical Company. The person selected will sell and promote the sale of prilled ammonium nitrate for its use as a blasting agent. This is a permanent position offering considerable opportunity to advance with an expanding organization.

In reply, please send resume of experience, education, age and salary requirements to:

Personnel Manager
Spencer Chemical Company
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STEEL PLATE
PRICED FOR QUICK SALE
3000 Tons ¼" to ¾" Adaptable for Chutes, Hoppers and Bins.
BRILL EQUIPMENT COMPANY
DESTREHAN (Near New Orleans) LA.
NORCO 6571

1—14 BU Joy AC Loader
2—512 Goodman Machine with Duster AC
3—400L Long Conveyor complete
2—212AA Goodman Cutting Machine
3—35L Jeffrey Cutting Machine
1—600 Ton Steel Bin Like New

ROTARY CONVERTERS

3—750 KW 600 volt 1200 RPM Westinghouse Serial Number over 8 Millions Fabricated Based
1—500 KW 600 Volt 1200 RPM Westinghouse
2—500 KW Westinghouse 250/275 volt 1200 RPM
1—300 KW Westinghouse 1200 RPM
2—300 KW G.E. HCC6 Form P 1200 RPM
2—200 KW G.E. HCC6 Form P 1200 RPM
2—150 KW Westinghouse 1200 RPM
1—100 KW G.E. TCC6 Form P 1200 RPM
2—100 KW Westinghouse 1200 RPM

Transformers any voltage for above switching gear, & panel boards.
Mining machines, ITE circuit breaker, hoist, transformers and other items too numerous to mention.

J. M. ALLARA COMPANY
JAEGER, W. VA.
WELLS—88072 Shop. WELLS—82156 or 82470 Night

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TRANSFORMERS
NEW • REBUILT
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WORLD'S LARGEST INVENTORY
CALL COLLECT GL 3-6783
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J. T. FISH SAYS: LOOKING FOR BARGAIN PRICES?

You Ain't Seen Nothing Yet—Here Is A BUYER'S PARADISE!

WE BUY—SELL—TRADE

JOY EQUIPMENT—REBUILT

3—Joy 14BU Loaders, low pedestal, 7AE, 1956 & 57
1—Joy 14BU Loader, low pedestal, 7AE.
6—Joy 14BU Loaders, medium pedestal, 7RBE.
4—Joy 14BU 3PE Loaders.
6—12BU10E Joy Loaders complete with Piggybacks.
2—Joy 12BU Loaders, 9E, latest type.
1—Joy 20BU Loader, latest type.
2—Joy 11BU Loaders, latest type.
1—Joy 8BU Loader, 34″ overall height.
2—Joy 8BU Loaders, 220 V. AC.
1—Joy curved Bar Head, complete.
6—Reliance 24-J Motors, 7½ H.P.
10—Reliance 38-J Motors, 10 H.P.
20—9-J Motors, 4 H.P.
2—Goodman 660 Loaders on Crawlers 440 V. DC, like new.
1—Goodman 660 Loader on Crawlers, excellent 250 V. DC.
1—Goodman 665 Loader on Crawlers, latest type 250 V. DC.
1—Goodman 865 Loader, 26″ hi. Rebuilt. 250 V. DC.
4—Joy 8SC Shuttle Cars, rebuilt.
4—Joy 6SC Shuttle Cars, rebuilt.
3—Joy 6SC Shuttle Cars, Latest type.
1—Joy 5SC Shuttle Car. Excellent.
2—Joy 32E9 Shuttle Cars.
2—Joy 32E10 Shuttle Cars, rebuilt.
2—Joy 32E15 Shuttle Cars, rebuilt.
4—Joy 32E16 Shuttle Cars, rebuilt.
2—Joy 42E16 Shuttle Cars, rebuilt.
1—Joy CD-22 Drill, on rubber, like new.
6—Joy T-2-5 low pan Crawler Trucks.
1—Joy T-2-6 low pan Crawler Truck with reel.
2—Joy T-1 Standard Crawler Trucks, 220 AC.
1—Joy T-1 Standard Crawler Truck, 250 DC.
2—Goodman low pan Crawler Trucks, like new, latest type.
4—Joy 11-B Cutting Machines, like new, 35 & 50 H.P.
1—Joy 7-B Cutting Machine, like new, 250 V. DC.
2—Goodman 212 Cutting Machines, 19″ high.
4—Goodman 312 Cutting Machines, 17″ high.
3—Goodman 412 Cutting Machines, 19″ high.
1—Goodman Machine on Crawler, 31″ high. All hydraulic.
6—Goodman 512 Machines with Bugdusters.
6—Goodman 612 Cutting Machines, 250 and 500 volt.
1—Lee Norse low vein Machine Carrier on rubber.
1—Jeffrey 70 URB rubber tired Cutter, Universal head, perfect condition.
1—Joy 11RU Rubber Tired Cutter with bugdusters, Universal heads, like new. 250 V. DC.
2—Joy 10RU Rubber tired Cutters, Universal head, 220/440 V. AC. Perfect.
6—7AU's on track. Universal head.
2—Jeffrey 29UC Cutting Machines. Universal head, cuts anywhere in seam, 38″ high, on Crawlers, 250 volt DC.
1—Jeffrey 29LC on Crawlers, rebuilt.

LOCOMOTIVES

1—Goodman 6 ton, 91-A, 27″ high, armor plate frame.
2—Jeffrey, 13 ton, type MH-110, 36″, 42″, 44″ ga.
2—Jeffrey, 10 ton, type MH-110, 42″ and 44″ ga.
2—Jeffrey, 10 ton, type MH-78, 42″ and 44″ ga.
2—Goodman 8-30 and 10-30 Locomotives, 26″ above rail.
1—Jeffrey MH-124, 6 ton, 24″ overall height.
12—Jeffrey, 6 ton, type MH-88, 42″, 44″ and 48″ ga.
4—Jeffrey 8 ton, type MH-100 2½″ armor plate frames.
1—Jeffrey, 6 ton, type 2186, 22″ above rail.
3—Jeffrey, 4 ton, type MH-96, 42″, 44″, 48″ ga.
1—G.E., 4 ton, type 825 Locomotive, 22″ high.
10—G.E., 6 ton, types 801, 803, 821 Locomotives, 42″, 44″ and 48″ ga.
1—G.E., 8 ton, type 822 Locomotive, 44″ ga.
3—G.E., 10 ton, type 809 Locomotives, 42″, 44″ and 48″ ga.
2—Goodman, type 33, 6 ton, 44″ and 48″ ga.
3—Westinghouse, type 902, 4 ton, 42″ and 48″ ga.
2—Atlas Battery Locomotives 36″ ga.
1—Atlas Trolley Locomotive, 4 ton, 24″ high.
2—Westinghouse, type 904, 6 ton, 44″ and 48″ ga.
2—Westinghouse, type 906, 44″ and 48″ Ga.
2—Westinghouse, type 907, 10 ton, 44″ and 48″ Ga.
8—Jeffrey MH-78 Locomotive Units, cheap.
4—Jeffrey MH-88 Locomotive Units, real bargains.
6—Jeffrey MH-100 Locomotive Units, reasonable.
3—Plymouth Diesel Locomotives, 8 and 10 tons, 42″ and 44″ Ga.
Locomotive Trucks and Spare Armatures for all the above.

TIPPLE EQUIPMENT

1—Complete Five Track Tipple with Washers and Air Tables.
5—Complete Tipples, 3 to 5 track, steel and wood.
3—Cleaning Plants, 1 Ea. McNally, Roberts and Schaefer, Jeffrey, Washers and Air-Flo Tables.
4—Complete Aerial Trams for coal or refuse.
3—Complete Rope and Button Lines.
2—Monitor Lines complete with Drums, excellent.
3—Allis-Chalmers 5′ x 12′ Low-Head Vibrators.
2—Allis-Chalmers 5′ x 12′ Rippflo Vibrators.
1—Allis-Chalmers 4′ x 12′ Low-Head Vibrator.
1—Robins Gyrex Vibrator, 4 x 10.
10—Belt and Apron type Loading Booms.
6—Shaker Screens.
1—Robins Car Shakeout.
20—Crushers, various sizes—Gundlach, Jeffrey, McLanahan & McNally
4—Mine Scales, 10 & 20 ton.
5—Truck Scales, 25 to 40 ton, late type
Feeders, Belt and Drag Conveyors, Car Retarders, etc.

CUTTING MACHINES

2—Joy 10RU rubber tired Cutters, Universal Head, 220/440 volt AC. Perfect
1—Joy 11RU, rubber tired Cutter, 250 V. DC.
1—Jeffrey 70 URB Cutter, rubber tired, Universal Head, low vein.
2—Jeffrey 29UC Universal Machines on Crawlers.
1—Goodman on Crawlers, 31″ overall height.
3—Baby Goodman 212's, rebuilt, 250 V. DC.
2—Goodman 212 Cutting Machines, 19″ high.
4—Goodman 312 Cutting Machines, 17″ high.
3—Goodman 412 Cutting Machines, 19″ high.
6—Goodman 512's, with Bugdusters, like new.
4—Goodman 512's, rebuilt, or as removed from service.
3—Goodman 112's, 220/440 V. AC.
1—Joy 7-B Cutting Machine. 250 V. DC.
4—Joy 11B Cutting Machines, rebuilt, 35 & 50 H.P.
6—7AU's, on track, Universal Head.
10—Goodman 12AA's and 112AA's, 250 V. DC.
2—Goodman 324 Slabbers.
2—Goodman 724 Slabbers.
2—Goodman 824 Slabbers.
6—Jeffrey 35L's, like new, 17″ high.
2—Jeffrey 35L's, on low vein trucks.
15—Jeffrey 35B's and 35BB's.
2—Jeffrey 29B's on track.
2—Jeffrey 29C's, track mounted.
2—Jeffrey 29L's, on Crawlers. Excellent.
3—Sullivan CE7, 220 AC.

CONVEYORS

2—Robins 36″ tandem drives, with or without structure.
2—Joy 30″ Underground Belt Conveyors, 500′ to 2000′ each. Excellent.
1—Goodman 97-C, 30″ Conveyor, 1500′ long.
2—Goodman 97-C, 26″ Conveyors, 1,000′ long.
3—Robins 30″ Belt Conveyors, 200′ to 2000′.
4—Jeffrey 52-B, 30″ Drive and Tail Assembly, complete.
2—Joy MTB 30″ Drive and Tail Assembly, complete.
3—Goodman 97 HC 30″ Drive and Tail Assemblies, complete.
4,000 Conveyor Belt, 36″.
8,000 Conveyor Belt, 30″.
4,000 Conveyor Belt, 26″.
8—Jeffrey 61AM 12″ Chain Conveyors, 300′.
2—61EW Elevating Conveyors.
2—61WH 15″ Room Conveyors, 300′.
2—Joy 15″ Room Convevors, 300′.
2—Joy 20″ Convevors, 300′.
4—Joy Ladel UN-17 Shakers.
10—Goodman G-12½ and G-15 Shakers.
3,000′ Goodman 18″ Flat Belt Conveyors, tandem drive, any length Perfect.
2,500′ any length. Perfect.

CONVERTERS AND DIESEL PLANTS

1—300KW Portable Rectifier, 3 car unit, excellent.
2—500KW G.E. Stationary Rectifiers.
4—1,000KW Stationary Rectifiers.
2—100KW, G.E. TCC-6's, 275 V., Rotary Converters.
1—150KW, G.E. HCC-6, 275 V., Rotary Converter.
1—150KW, 6 phase, Allis Chalmers Rotary Convevor. 275 V. D.C.
2—200KW G.E. HCC-6's, Rotary Converters, 275 V. DC. Newly rewound.
3—300KW G.E. HCC-6's, Rotary Converters, 275 V. DC. Like New.
2—300KW Westinghouse 6 phase, Rotary Converters. 275 V. DC.
2—500KW Westinghouse Rotary Converters, 275 V. DC.
2—200KW Westinghouse Rotary Converters, 275 V. DC. Newly rewound.
(All the above with 6900/13000 and/or 2300/4000 primary transformers)
2—100KW MG Sets, 275 V. DC.
2—150KW MG Sets, G.E. and Westinghouse, 275 V. DC.
1—200KW MG Set, Westinghouse, rebuilt, 275 V. DC.
1—200KW MG Set, G.E., perfect, 275 V. DC.
2—300KW G.E. MG Sets, like new.
1—300KW Westinghouse, 600 volt MG Sets, rebuilt.
2—300KW Westinghouse, 600 volt, 6 phase, Rotary Converters.
2—500KW Westinghouse, 600 volt, DC, 6 phase, Rotary Converters.
2—500KW HCC-6's, Rotary Converters, 6 phase, 600 V. DC.
1—GMC-471 Diesel with 60KW, 250 V. DC Generator.
2—GMC-671 Diesels with 75KW, 250 V. DC Generator.
1—Cummins 125KW Diesel with 250 V. DC Generator.
1—Cummins 125KW Diesel with 250 V. DC Generator.
1—Allis-Chalmers Natural Gas Engine with 100KW Generator, 275 V. DC.
Boilers, like new, 500 H.P.

LOADING MACHINES

3—Joy 12BU9E Loaders, latest type.
6—Joy 12BU with Piggyback Conveyors.
16—Joy Loaders, 14BU, 12BU, 8BU, 11BU, 20BU
2—Goodman 865 Loaders, 26″, on Crawlers.
1—Goodman 665 Loader, on Crawlers.
2—Goodman 660 Loaders, 440 V. AC, perfect.
1—Goodman 660 Loader, on Crawlers.
1—Goodman 460, on track, Rebuilt.
2—Jeffrey 61 CLR's on rubber, 26″.
3—Jeffrey L-500 Loaders.
2—Myers Whaley, No. 3 Automatic Loaders.
2—Clarkson Loaders, 26″ above rail.

MISCELLANEOUS

1—Complete Five Track Tipple with Washers and Air Tables.
5—Complete Tipples, 3 to 5 Track, Wood and Steel.
Steel Trestles for drop bottom cars.
All Steel Armco Buildings
20—Jeffrey Molveyors on rubber tires.
1—¾ Yard Shovel and Back-Hoe.
1—¾ Yard Crawler Crane.
Battery Supply Tractors, Rubber tired.
1—Cantrell Air Compressor on rubber tires.
10—Air Compressors, 1 H.P. to 40 H.P.
2—Joy self-propelled rubber tired compressors, 240 cu. ft.
2—Acme Self Propelled rubber tired compressors 130 cu. ft.
40—Mine Pumps, all types.
1—Differential 40 Passenger Man-Trip Car.
6—MSA Rock Dusters.
2—Phillips Carriers, 44″ and 48″ ga.
1—Barber-Greene self-propelled Bucket Elevator.
Pipe, Plastic, Steel, Transit, all sizes 1″ to 6″.
300—Mine Cars, drop bottom, 42″ ga.
90—Mine Cars, drop bottom, 44″ ga.
50—Mine Cars, drop bottom, 48″ ga.
100—Mine Cars, 18″ high, end dump, 44″ ga.
300—Mine Cars, end dump and drop bottom, 20″ high, 48″ ga.
1—10 ton Mine Car Scale with Recorder.
15—Brown Fayro HKL and HG Car Spotters.
1—Brown Fayro Hydraulic Car Spotter.
1—12 ton Differential Slate Larry.
Incline Hoists, 25 to 50 H.P.
1—Jeffrey 5′ Aerodyne Fan, like new.
1—Jeffrey 6′ Aerodyne Fan.
1—Jeffrey 8′ Aerodyne Fan.
2—Storage Tanks, 4,000 Gallons.
2—Storage Tanks, 10,000 Gallons.
10,000 Five Gallon G.I. Cans, screw lids.
2,500 tons Relaying Rail, 25lb., 30lb., 40lb., 50lb., 60lb., 70lb.
30 Tons Copper—4/0 and 9 Section Trolley 1/0, 2/0, 4/0 Stranded.
Thousands of feet of rubber covered three conductor cable, All sizes.
300—Transformers from 1 to 300 KVA, 110 to 13,000 primary volts.
400—Electric Motors, 3 to 250 H.P.
Huge Stock of Mine Supplies
600—MSA Mine Lamps, Chargers, etc.
4—Mine Scales, 10 & 20 ton.
5—Truck Scales, 25 to 40 ton, late type.
Tandem Dump Trucks.
THOUSANDS OF OTHER ITEMS.

WE OWN WHAT WE ADVERTISE

PHONE PL 2-4400 — **J. T. FISH** — **LOGAN, WEST VA.**

TO LOWER YOUR MINING COSTS

Check our listing of modern mechanical equipment — whether to completely mechanize or further mechanize your operation — we offer the most complete stock of used and rebuilt machinery.

BUY — SELL — TRADE **IF WE ADVERTISE IT — WE OWN IT**

A.C. MINING EQUIPMENT FOR SALE

1—50 H. P. Goodman Standard, 220 Volt A.C., Cutting Machines
3—11BU-10APH Joy Loading Machines, 220/440 Volts A.C.
1—8BU-11G Joy Loading Machines, 220 Volts A.C. (can be changed to 440 Volts A.C.)
2—4JCM Joy Continuous Miners, 440 Volts A.C.
1—10RU Joy Cutting Machine, 220/440 Volts A.C.
3—512 Goodman Cutting Machines, 220/440 Volts A.C.
3—7B Sullivan Cutting Machines, 220/440 Volts A.C.
1—8BU Joy Loading Machine, 220 Volt AC, 31" high, equipped with stub boom for PT-12 Piggyback
1—8BU Joy Loading Machine, 220/440 Volt AC.

LOADING MACHINES FOR SALE

1—18 HR Joy Loading Machine, 250 Volts D.C.
4—11 BU-10APE Joy Loading Machines, 250 Volts D.C.
1—11 BU-11APE Joy Loading Machine, 250 Volts D.C.
4—14 BU-7BE Joy Loading Machines, 250 Volts D.C.
2—14 BU-3PE Joy Loading Machines, 250 Volts D.C.
6—12 BU-9E Joy Loading Machines, 250 Volts D.C.
3—8 BU Joy Loading Machines, 250 Volts D.C.
3—7 BU Joy Loading Machines, 250 Volts D.C.
1—665 Goodman Loading Mach. 250 Volts D.C.
2—Long 12" Piggyback Conveyors, each 300' long, complete with PT-12 Piggybacks and 12BU Joy Loading Machines.
1—11BU-14E Joy Loading Machine, 250 Volt DC, 75 H.P. Main Motor, Serial No. 5803.

SHUTTLE CARS FOR SALE

2—10SC-1E Joy Shuttle Cars, 250 Volt DC, completely modern.
1—570-48 Goodman Shuttle Cars, 250 Volts, D.C.
4—5SC Joy Shuttle Cars, Matched Pair, Elevating Discharge, Disc Brakes, 250 Volts D.C.—Modern.
2—6SC-7E Joy Shuttle Cars, Matched Pair.
2—6SC-5E Joy Shuttle Cars, Elevating Discharge, 4-Wheel Steering, 250 Volts D.C.
3—42E18 Joy Shuttle Cars, Disc Brakes, Elevating Discharge, Completely Modern, 250 Volts, D.C. 2-Standard, 1-Opposite Standard Drive.
1—Jeffrey Shuttle Car, 4-Wheel Drive and Steer.
1—32E16 Joy Shuttle Cars, Disc Brakes & Elevating Discharge.
1—42E15A Joy Shuttle Car.
1—32 E-7 Joy Shuttle Car.

CUTTING MACHINES FOR SALE

1—512 CJ Goodman Cutting Machine, 50 H.P. with bugduster.
1—11RU Joy Cutting Machine, 250 Volts D.C. with 9' Cincinnati Bar, Chain and bugduster.
1—10RU Joy Cutting Machine, 250 Volt D.C. with bugduster.
2—29UC Jeffrey Universal Cutters, Permissible, 250 Volts D.C.
1—512 CCH Goodman Cutting Machine, 250 Volts D.C.
5—35B Jeffrey Cutting Machines, 250 Volts D.C.
6—35BB Jeffrey Cutting Machines, 250 Volts D.C.
1—35 LC Jeffrey Cutting Machine, 35 H.P.
2—29LC Jeffrey Cutting Machines, 250 Volt D.C.
2—512 EJH Goodman Cutting Machines
2—512DA Goodman Cutting Machines, 250 Volts D.C.
2—7AU Sullivan Cutting Machines, 250 Volts D.C.
3—212 AB Goodman Machines.
2—412 AA Goodman Machines.
1—35L Jeffrey Machine 35 H.P.

CONTINUOUS MINERS FOR SALE

3—4JCM Joy Continuous Miners, 440 Volts A.C.

RECTIFIERS FOR SALE

1—150 KW General Electric Stationary Rectifier, 440 Volts Primary, 275 Volts D.C., Serial No. 6628.

ROTARY CONVERTERS FOR SALE

1—150 KW Rotary Converter, Serial No. 1054562, with 150 KVA transformer and panel boards.
1—300KW Westinghouse, Pedestal Type Converter, 275 Volts D.C., Primary 2300/4000.

COAL DRILLS FOR SALE

25—CP-472 Electric Coal Drills, 250 Volts D.C.
5—CP-572 Coal Drills.
1—Chicago Pneumatic RBD-30 Roof Drill, Serial No. A858913.
10—Chicago Pneumatic Little Giant 572 Coal Drills, 3 phase, 220 Volt AC Permissible. New.

CRUSHER FOR SALE

1—36" x 36" Double Roll Crusher, complete with 100 H.P. Motor.
1—18" x 30" Double Roll, Double Drive, Scottdale Crusher.
1—Cedar Rapids 20" x 30" Swing Hammer Crusher with 40 H.P., 220/440 Volt AC Motor.
1—Robins 36" x 36" Double Roll Stoker Crusher, specially built with spike teeth equipped with extra set of new segments.
1—Scottdale 20" x 30" Double Roll, Double Drive Crusher.

COMPRESSORS FOR SALE

3—Acme Self-propelled Air Compressors, 83R, Model 168, Capacity 176CFM, with 40 H.P. Reliance Compound Motor. Excellent Condition.

LOCOMOTIVES FOR SALE

1—10 Ton Goodman Locomotive, Serial No. 4371—Type 32AO4-T, 250 Volt D.C., 42" track gauge. Height 34".
1—MH-150 Jeffrey Locomotive, 42" track gauge, 250 Volt D.C., 26½" high, rebuilt.
1—MH-88 Jeffrey Locomotive, 30" high with CY-21 Reel, 44" track gauge.
1—General Electric 6 Ton Locomotive with Reel, 36" gauge.

ROCK DUSTERS FOR SALE

1—MSA Track Mounted Rock Duster, 10 H.P., A.C. or D.C., high pressure, 30" high, any gauge.
2—MSA Bantam Rock Dusters, Rubber Tired, Portable.
2—MSA Bantam Rock Dusters, Skid Mounted.
1—American Mine Door, Wheel mounted bantam type rock duster, 250 Volts D.C., 22" high.

HOISTS FOR SALE

10—#11½ Vulcan-Denver Material Hoists, Complete with 3 H.P. D.C. Compound Wound 1750 RPM General Electric Motor.
2—Brownie Hoists, Model HKL—Good condition.
1—Brownie Hoist, Model HKM—Good condition.
3—Sullivan Type CHL 5 H.P. Car Spotting Hoists.

ELEVATORS FOR SALE

1—PL11-14 Joy Elevator.
2—Joy PL11-16 Elevating Conveyors.

MACHINE TRUCKS FOR SALE

1—Goodman Low Vein Truck.
4—T2-5APE Joy Trucks, 250 Volts D.C. Permissible.
2—T2-5APE Joy Machine Trucks, 250 Volt D.C., equipped with hydraulic system for drill.

CHAIN CONVEYORS FOR SALE

5—61AM Jeffrey Chain Conveyors, 10 H.P. 300' long.
3—61HG Jeffrey Chain Conveyors, 5 H.P. 40' long.
700 ft. Goodman 30", 97C Structure complete with drive.
1—LaDel 30" Tandem Belt Head and Tail.
3—Joy 15 H.P. Heads and Tails.
200 ft.—Joy 15" Pans and Chains.

DIESEL PLANTS FOR SALE

1—60 KW, G.M. Diesel Generator Set, with 60 KW, 250 Volt D.C. Delco Generator.
1—100 KW Waukesha Diesel Generator with 220/440 Volts D.C.
1—100 KW Diesel Generator Unit, with G.M. Diesel Engine and 100 KW Generator.
1—D13000 Caterpillar Diesel Generator Unit—with Caterpillar engine and 75 KVA G.E. generator self-regulating, 220 Volt A.C.
1—250 KW Diesel Generating Plant, consisting of Westinghouse 250 KW 275 Volt Compound Wound Generator driven by Twin 6110 General Motors Engines, Complete with switchgear and all appurtenances. New in 1956.

MOTOR GENERATORS FOR SALE

1—50 KW Westinghouse MG Set, 440 Volt AC, 250 Volt DC.
1—300KW Westinghouse Motor Generator Set synchronous motor, 433 KW Output, 435 KVA, 2200 Volts, 1200 RPM. D.C. generator 300 KW, 275 Volts, 1200 RPM. Compound Wound. Complete with D.C. panel and switch gear.
3—50 KW G.E. and Westinghouse Motor Generator Sets, 2300 Volts A.C., 275 Volts D.C. Complete with switching gear.
1—200 KW Ridgeway Motor Generator Set, Complete with switchgear and 1600 amp. I-T-E automatic circuit breaker, 2300 A.C., 275 Volts D.C.

BELT CONVEYORS FOR SALE

2 only 1200' 26" Belt Conveyors with 30 H.P. 250 Volt D.C. Drives.

MISCELLANEOUS FOR SALE

3—35B Jeffrey Armatures, 250 Volts DC.
4—902, 250 Volts D.C. Westinghouse Motor Units, only.
1—R5E Jeffrey Reel and Motor, complete.
1—PL 11-14 Joy Elevator.
10—Goodman 512 Cutter Bars and Chains.
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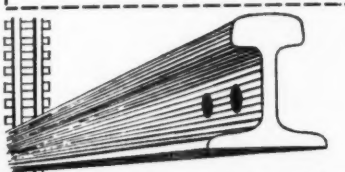

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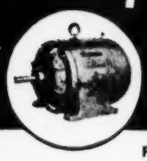

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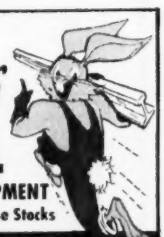

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...cost less per hour

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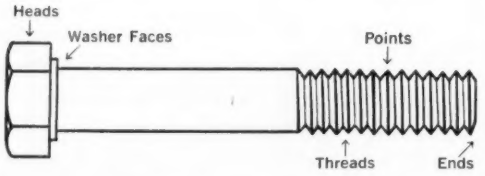
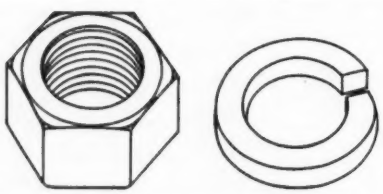
Ever twist a head off a bolt because it wasn't *strong* enough . . . or scrape your knuckle when your wrench "rounded off" the head because it wasn't *hard* enough? It's not likely to happen if you use Cat all-purpose bolts and nuts. They're highest quality in every way. For example, Cat bolts exceed Grade 6 in all requirements as rated by the Society of Automotive Engineers. Grade 5 is the average rating of bolts used in other earthmoving equipment.

WHAT GRADE OF BOLTS DO YOU USE?

Here's what's normally stocked at...	Hardware Stores, Automotive Outlets	Industrial Supply Houses, Other Mfr. Outlets	Special Order Only	Caterpillar Dealers
SAE	Grade 0-3	Grade 5	Grade 6	Exceeds Grade 6
Minimum Tensile Strength (Breaking point)	55,000-110,000 PSI	105,000-120,000 PSI	133,000-140,000 PSI	142,000 PSI
Hardness Rockwell Rating	RC 0-28	RC 19-32	RC 28-36	RC 30-38

If you need tougher, stronger hardware—get Cat all-purpose bolts and nuts. You can count on them to do a better job longer because they're stronger and harder than others.





HERE ARE OTHER CAT BOLT BONUSES YOU GET. *Heads* are higher and full size—easy to get wrenches on. *Flats* are hard and parallel—corners don't round off, are easy to grip. *Threads* are rounded at the roots and free from laps and burrs. *Points* are smooth and uniform. *Ends* are precisely rounded or chamfered—cross-threading doesn't occur. *Washer faces* are flat and have uniform thicknesses. *Heads and threads* are concentric to shaft—heads and nuts fit flush.

NUTS AND LOCK WASHERS are matched to every size bolt to give complete top-quality fasteners, too. Nut threads resist stripping. Corners do not round. Clean, smooth-fitting threads make installation fast and easy. Lock washers have smooth surfaces for maximum wear and strength.

When you need the best bolts and nuts to keep your machinery and other equipment together, see your Caterpillar Dealer. He has a large selection.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

SERVICE TIP: Get your free copy of Caterpillar's bolts and nuts reference booklet at your Caterpillar Dealer today. It has the sizes, threads and part numbers listed for quick, easy ordering. Before buying any hardware, check Cat prices first.

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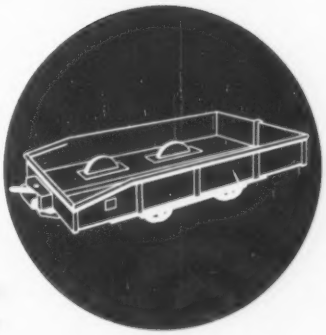
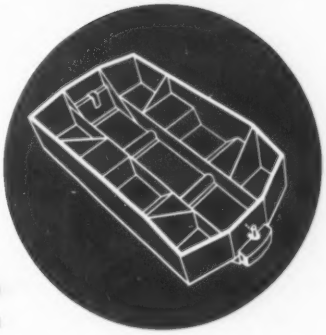
DROP BOTTOM
4 wheel or 8 wheel



END DUMP
4 wheel



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For complete information about the full line of **acf** Constant Haulage Mine Cars in all sizes and types contact the nearest **acf** sales office or discuss your haulage problems with one of our sales representatives.

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International Harvester's NEW coal preparation plant

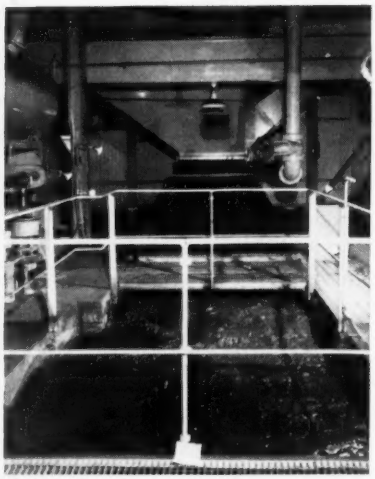
turns D-seam coal into grade-A product

Plant is a model of simplicity and efficiency . . . was designed and built entirely by LINK-BELT

For many years, the B and C seams of this mine provided clean metallurgical coal for the Wisconsin Steel Division of International Harvester Company. But the currently mined D seam poses a problem . . . its coal requires preparation before it can be fed to the plant's coke ovens in Chicago.

The new coal preparation plant, built and equipped by Link-Belt, solves the problem . . . processes 400 tph of R.O.M. coal. Only a small amount of equipment is required and all operations are integrated with a high-capacity Link-Belt air-pulsated wash box into which coal is fed and automatically separated from refuse. The end result is a uniform, high-quality product.

Perhaps Link-Belt's coal preparation equipment and more than 60 years' experience can be put to work for you. For details, contact your nearest Link-Belt office or write for Book 2655. Ask too about our color-sound film, "Preparation Makes the Product." It's available free for group showings. 15.274



LINK-BELT AIR-PULSATED WASH BOX receives coal at a rate of 400 tph. Clean coal flows through the box and settled heavy rejects are withdrawn by refuse wheels. After leaving the wash box, float coal is dewatered and sized on a Link-Belt double-deck vibrating screen.

LINK-BELT

COAL PREPARATION AND HANDLING EQUIPMENT

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70-FT. DIAMETER CIRCULAR THICKENER is part of a Link-Belt water-clarification system at International Harvester's new preparation plant at its Wisconsin Steel Coal Mines, Benham, Kentucky. The system recovers fines, recirculates water, prevents stream pollution.